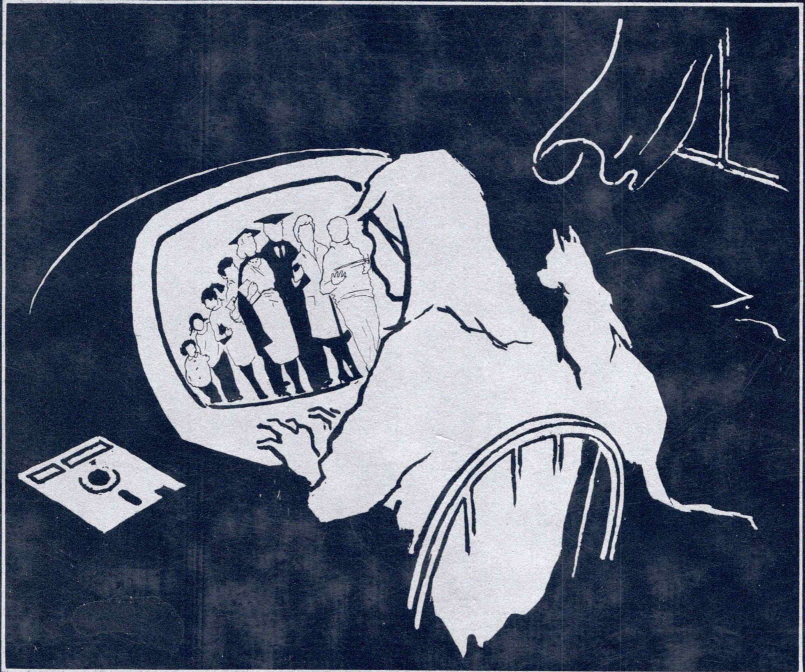
LOOKING BACK TO TOMORROW

REFLECTIONS ON TWENTY-FIVE YEARS OF COMPUTERS IN NEW ZEALAND



Even though the computer has become so much a part of our everyday life, we still seem to think of it as 'new'. Therefore it comes as something of a shock to realise that we have been living in the computer age for a quarter of a century. The formation of the New Zealand Computer Society and the entry of the first electronic computer into this country came, in that order, in 1960. Since then the rate of progress has been staggering. Today our small pocket calculators can do the work that previously required a computer the size of a room.

This book has something for us all. It unfolds the history of the computer, how it came to New Zealand and the impact it is making on our society. We are given tantalising glimpses of what the future holds, but a warning note is sounded that New Zealand should beware lest we find ourselves left behind the rest of the computing world.

For those who have been closely involved with computers in New Zealand it will bring back memories of early days. For new converts there will be much to learn from the problems that have been overcome, and there are fascinating insights into problems still to be resolved.

The book does not dodge these problems and it leaves the reader in no doubt that kiwi ingenuity can win the day.

NZCS

LOOKING BACK TO TOMORROW

LOOKING BACK
TO
TOMORROW

A survey of the impact of the first twenty-five years
of the use of electronic computers in New Zealand
together with some thoughts for the future.

Edited by W.R. Williams, MNZCS, RNZN (Retd.)

NZCS

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The editor would also like to express his personal thanks to the contributors. They have willingly undertaken a considerable amount of work in research, writing and proof reading their individual chapters. This in addition to their normal busy round of activities.

The opinions expressed in *Looking Back to Tomorrow* do not necessarily reflect the position or policy of the New Zealand Computer Society.

Foreword by the Rt. Hon. D.R. Lange,
Prime Minister of New Zealand.

It is timely that this anniversary publication comes in the first year of operation of the Technology Advancement Trust. The Silver Jubilee book presents a valuable record of the formative years of the data processing industry in New Zealand.

The Technology Advancement Trust looks ahead to what comes next.

It is essential if we are to maintain our place in the world that we take full advantage of the new technology. In particular, it is those who make the best use of the wealth of information that is becoming available through computer based systems who will prosper.

Computers are playing an ever-increasing role in our lives. New Zealand cannot afford to lag behind.

If industry in New Zealand is to be efficient it must come to terms with the incredible pattern of development and obsolescence. There are opportunities for New Zealand. If we do not take them, we are likely to be faced with the increasing obsolescence of our industries by world standards and increasing difficulties for our exporters.

As we move ahead in the use of computer technology there needs to be a constant awareness that the virtues of technology are not unqualified. Technological changes inevitably raise concerns – that jobs will be lost – that the quality of life will diminish.

As the New Zealand Computer Society embarks on its next twenty-five years of work, I remind all those in the business of the advancement of technology to do so with responsibility.

Encourage the widest possible public awareness of the advantages and disadvantages of technology and promote the productive resolution of conflicts and differences.

I commend the Society for this fascinating publication and for guiding the development of computing in this country through its early years.

David Lange

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[illegible] information [illegible]

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INTRODUCTION

C.R. Boswell
President 1983–1985

In the past twenty-five years new methods of computing have changed the face of New Zealand. Over that period we have come from costly electromechanical sorters and tabulators requiring highly trained operators, to complex electronic computers at prices affordable by many families and which a child can operate. Not much more than twenty-five years ago there were no electronic computers in New Zealand. Now their numbers are legion.

The New Zealand Computer Society was formed twenty-five years ago, before the first computer had been installed in this country. New Zealanders were returning from overseas impressed by what they had seen of the new technology. They, and others in New Zealand, were aware that this country too could use these techniques to its benefit, and that the introduction of computers here was only a matter of time. A number of these far-sighted individuals met together and formed what was to become the New Zealand Computer Society, the body representing computer professionals in New Zealand.

Those early founders laid an excellent base and the Society has served its growing body of members well. It has gone from a small group of interested individuals with vision, acting on a voluntary basis, to an organisation of some 2500 members with a full-time secretariat and a wide variety of activities.

Since its formation the Society has perceived itself as having two complementary roles. Its first and major function is to look after the professional interests of its members. This has been done in a number of ways. Each of the five local branches of the Society holds a series of regular meetings where speakers address topics of interest to members. These range from the highly technical, such as details about new programming techniques or information on recent technical developments, to matters of more general interest including novel applications of computing. On the national level the Society provides opportunities for its members to learn from each other and from overseas practitioners by holding regular biennial national conferences. Trade exhibits at these conferences allow computer vendors to present their wares to both the profession and to the interested public. Since its earliest days the Society has published newsletters and bulletins and currently it has an agreement with Associated Group Media whereby members receive the magazine *Interface* as part of their subscription and the Society has a number of pages in each issue. In more recent years the Society has been offering a programme of professional continuing education, increasing the number and variety of topics addressed each year. In its attempts to keep members up to date with overseas developments the Society has established links with the British and Australian Computer Societies and is the New Zealand representative on the International Federation for Information Processing (IFIP). New Zealanders, through the NZCS, are members of many of the technical committees of IFIP and are thus able to keep us up to date on important developments overseas.

The Society's other role is in its perceived obligations to society in general. The Society is seen by the public as the independent and authoritative source of information on matters to do with computing and its social impact. This has come about because the Society in its public statements has drawn attention both to the potential benefits of computers and to the possible dangers from their misuse. The success of this programme is demonstrated by the increased public awareness of the benefits of the applications of computers and the reduced amount of unjustified fear of this technology, based on a better informed awareness of the possibilities these systems offer for abuse and how they may be avoided.

As part of the Society's public role it has been involved with government, unions and employers. For example, the Society brought out the Nygaards, specialists on computing, employment and the unions in Norway, to talk about developments in Scandinavia and their possible application to New Zealand. The Society has been able to provide assistance to the government in a number of areas. These include; representation on the Wanganui Computer Centre Committee, the presentation of a number of submissions on privacy issues, providing representatives in the Auditor-General's enquiry into the use of computers in the Public Sector, advising on the revision of the electoral roll.

The Society has always had a major concern in the field of education, not only for its members and potential employees in the profession, but also in increasing the computer literacy of New Zealanders generally. To this end it has mounted its continuing education programme described above. It has also been extensively involved with the Authority for Advanced Vocational Awards in syllabus preparation and revision for the Diploma in Data Processing and the Diploma in Computer Engineering. The Society has provided assistance when requested by the Technical Institutes. It has close links with the Vocational Training Council where it is represented on a number of committees and liaises closely with universities. The Society provides prizes for the best student in data processing in the AAVA examinations and for the best students in selected computing papers at the universities. The Society has also provided assistance to the Department of Education and the Labour Department in the area of vocational guidance.

The Society also accepts as a fundamental principle that its members, and indeed the country as a whole, will benefit from the establishment of a firmly based, expanding electronic computing industry in New Zealand. It has therefore devoted much of its resources to achieving this end. It has lent its weight to submissions to reduce sales tax on computer hardware and was largely instrumental in finally persuading the authorities that there should be no sales tax on computer software. It has held seminars on the export of computer software and has also been heavily involved in the issue of the legal protection of software.

Above all the Society is continually seeking to improve the status and skills of computing professionals. It is doing this by providing a means of measuring excellence by setting high standards for the professional grade of Member. Full Members of the Society have demonstrated, both by achievement and by peer evaluation, that they are truly professional in both their abilities and qualities and are recognised as such. The Society has a Code of Ethics which is binding on all Members and Associates and hopes to have a Code of Practice in place shortly.

In its first twenty-five years the New Zealand Computer Society has evolved into a dynamic, professional, socially aware body. The next twenty-five years will see a growing penetration of the new technologies into the fabric of our society which will change it profoundly. The NZCS is well placed to meet the new challenges and will continue to serve its members and society at large as well as, if not better than, it has in the past.

CHAPTER ONE

AOTEAROA BEFORE THE COMPUTER

W. Winiata

Whatarangi Winiata holds a Ph.D. in Finance and is a Fellow Chartered Accountant. He is Tumuaki (Chairman) of the Department of Accountancy at Victoria University. He also has wide ranging interests in Maori culture and the heritage of the Maori people being Kaiwhakaako (Instructor), Te Wananga O Raukawa (University of Raukawa).

This review of the information systems of the Maori is, at once, both larger and lesser than the theme on which I was invited to write, namely, 'New Zealand before the Computer'. It is larger in that it is more venturesome than was anticipated, surveying territory hitherto unexplored by specialists in computers and information systems, and I hope that they will forgive the intrusions by this non-specialist.

It is lesser in two ways. Firstly, the range of experience on which it focusses is peculiar to only one section of the population of Aotearoa, namely, the Maori. Secondly, it lays stress on the storage and transmission of information, this being a vital aspect of Maori information systems.

A short review of the *whakapapa* of the family of electronic computers which exist in this country in 1985 would start in the 1960s. Indeed, it is customary to refer to the machines of that era as first generation computers. A long view of computer ancestry would, of course, take us back 120 generations or more to the origins of the abacus and beyond. Here I have taken the short-view on computer ancestry and a long-view on Aotearoa before the computer! It is not possible and, for our purposes, not necessary to document and to date the development of Maori information systems. We know, of course, that the process began well before the 1960s.

Any accumulation of information which is accessible to the possessor or to others is an information system, regardless of the type of information being stored or the method of storage. It follows that we have had human information systems for as long as we, as a species, have had the dual capacity to store information and to retrieve it as needed. It also follows that the nature of such systems and of their development will be as diverse as the human cultural scene, because the choice of information to be stored is determined by its prospective users and the method of storage chosen is from the options available to them. The users, their needs and their options are culture specific.

Information systems evolve in response to the needs of the community and, in turn, to the extent that community-wide planning occurs, the design and performance of information systems influence community progress and development. Accordingly, the extent to which a community will find it necessary and desirable to centralise its information system will be a function of the need for community-wide planning and monitoring. In the Maori case, planning was done by *whanau* (family), *hapu* (sub-tribe), *iwi* (tribe), or *runanga* (confederation of iwi) or *waka* (canoe grouping). Thus, Maori information systems were centred on the *whanau, hapu, iwi* or *waka* and their content was a reflection of what was seen to be important at each of these operating levels. Finally, given that the culture had not designed a written language the Maori had to rely heavily on the memorising capacity of the mind for storage and on a variety of external stimuli to assist with the process of retrieval.

The Pakeha arrived in Aotearoa with a written language and with well established information systems which employed this tool. The advancement of these systems occurred concurrently with advances around the globe and while some original contributions from Aotearoa to the world-wide enhancement of knowledge of computers and information systems have been identified, it is largely true that the Pakeha community has adopted processes refined elsewhere in the world.

We have observed that the human mind was the memory bank for the information system of the Maori. The task of selecting the minds to be developed to serve this purpose and of training those minds was assigned to *te whare wananga*, the school of learning, the object of which was:

> To preserve all desirable knowledge and to hand it down free of any alteration, omission interpolation or deterioration.

These would be worthy objects of any information system. We would want all desirable knowledge to be stored safely and its preservation to be assured. Moreover, we would like to guarantee that the integrity of this knowledge is maintained for succeeding generations of users. We have learned, however, that the analysis of alternative computer installations is complicated and that the choice of the 'right' facility difficult and risky even though the fundamental requirements, namely, to store and dispense information, are explicit. The Maori had a similar problem. Not every member of a *whanau, hapu, iwi, runanga* or *waka* had the requisite mental skills, namely, to store large amounts of knowledge and to recall and transmit it with absolute accuracy.

Consequently, the selection of storers and dispensers of knowledge was of major importance. It is clear that the commitment of those chosen had to be substantial and the energy expended in fulfilling the job must have been considerable even for the most talented. We have some insights into the remarkable accomplishments of some such people from the research of Elsdon Best who for two decades or more assiduously observed and recorded Maori life. In his monograph on *te whare wananga* he reports that during one winter he obtained from one Maori elder the words of 'no less than 406 songs, together with much information of an explanatory nature pertaining to them. All of these songs were given from memory – not one was in written form'.

A measure of this accomplishment can be obtained from the compilation of *waiata* (songs) known as *Nga Moteatea*, in which 300 songs with explanatory notes occupy 450 pages of printed text of which half is in Maori. This example given by Best implies a memory capacity of more than 300 pages of printed Maori text for the songs (460 of them) mentioned above.

In a second illustration of memorising power Best cites one person occupying three days of a sitting of a commission on land ownership while '... he traced the descent of his people from an ancestor who flourished thirty-four generations ago. The result was a long table of innumerable branch lines, of a multitude of affinitive ramifications'. In this instance the witness gave '... much evidence as to occupation, extra-tribal marriages ... and the genealogical table contained well over 1400 names'.

To the modern computer the task of storing the words and explanatory notes of 400 songs occupying 300 or more pages of print and of thirty-four generations of people and their activities would be trivial. However, the following challenges could be more than the most sophisticated computer is able to handle:

> To programme all possible cross references,
>
> To capture the tunes of these songs,
>
> To record and be able to reproduce the mood and rhythm that accompanies each song or recital of *whakapapa* with the speed and spontaneity (of retrieval) of those cited by Elsdon Best, and
>
> To exercise the appropriate culturally-determined restrictions or control in the sharing of the knowledge.

The major institution in the transmission process was, as we observed, *te whare wananga* (school of learning) wherein knowledge, under varying restrictive practices associated with different levels of *tapu* (sacredness), was taught to highly restricted and carefully selected classes. Very few people were entrusted with esoteric knowledge which was *tapu* (sacred) and could be transmitted and received only by people who, themselves, were in a state of *tapu* (sacredness). It is not possible for a computer to be *tapu* and we have learned that security (and control) of computerised information systems is extremely difficult to guarantee. Maori information systems, of course, were impenetrable if the repository resolved that it should be that way.

For any particular *whanau, hapu, iwi, runanga* or *waka* there was the constant search for candidates for *te whare wananga* for training to ensure that their respective information systems were maintained and that the content of these systems was transmitted in their entirety from one generation to the next.

Even in the most carefully managed situations there is always the risk that information will be lost, or that during storage or transmission it will change and become less reliable. Written or computerised information systems face these prospects as did the Maori systems; however one would suspect, that, where these problems occur they are easier to find in the modern computerised systems than they were in the Maori.

Regrettably, we are not able always to detect the existence of unreliable information or, indeed, to distinguish between reliable and unreliable interpretations of information even where its integrity has remained intact.

The point has been made that Maori information systems were decentralised. Local *whanau, hapu, iwi, runanga* or *waka* had their own versions of *whakapapa, waiata, karakia* (formularies or prayers) and descriptions of events. In a rather mechanistic but substantial research undertaken to gain deeper insights into the traditional accounts of the great migration, Simmons establishes criteria by which to evaluate local, typically *waka*, traditions. His criteria were the following:

> Occurrence in a number of sources (particularly of other *waka*).
> Occurrence in songs and chants (particularly those performed publically and as *karakia*).
> Persistence to present times (or traditional knowledge).
> Occurrence in early sources.
> Genealogical validation.

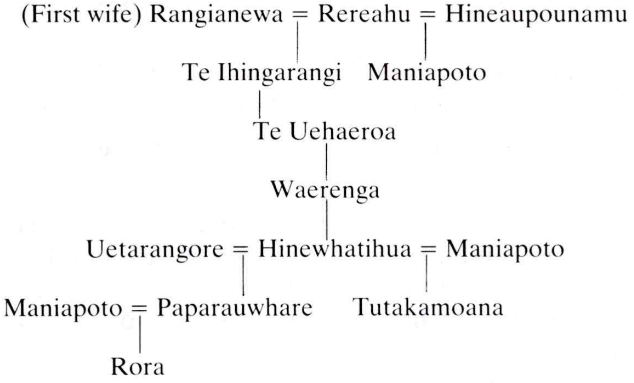
In the application of these criteria, a task which would have been greatly assisted by the use of a modern computer, Simmons concludes that the explorer Kupe was in Aotearoa 400 years later than the dating given by Percy Smith and taught to everyone since. A major point from his research is that the Maori information systems including, of course, their content, have more consistency than the interpretations assigned to them by Percy Smith and others.

With all this material to be remembered it is not surprising that the Maori resorted to external aids to memory. In the remarkable collection of studies of Maori life by Elsdon Best which are built on observations, analyses, descriptions and debates of subjects ranging from schools of esoteric learning to games and pastimes, from fishing methods (and devices) to agriculture, from the lore of the untamed forest to the ways of the orderly *pa* (village), from the *tihei* (sneeze) of human birth to the *mauri* (life essence) of stone implements, from marae fixtures (including storehouses and kindred structures) to the mobile *waka* (canoe) we find his writings woven together by *waiata, karakia, whakatauki* (proverbs) and *whakapapa*. These *waiata, karakia, whakatauki* and *whakapapa* were part of an elaborate framework of aids to the human memory.

Another scholar, Pei Te Hurinui well-known on the marae and in the academic community of Aotearoa, recognized the importance of the 'genealogical method' for 'fixing the sequence of events' and published the following illustration:

Raymond Firth, in his classical study of the economics of the Maori, refers to the use of mnemonic devices and cites the naming of meeting houses and of carvings and other art work therein as reminders of ancestors, events and circumstances. Descriptive labels for places, names for people or roles for gods served as reminders of outcomes, activities or prescriptions. Another well documented example of the aids used to assist memory is provided by the research of Saul Riesenberg. He describes some of the mnemonic devices and systems of classification employed by the navigators of the atoll of Puluwat (Central Caroline Islands) to arrange their know-

In the Maniapoto tribal history there are the well-known marriages of the eponymous ancestor, Maniapoto; firstly to the great-granddaughter, Hinewhatihua, of his elder half-brother, Te Ihingarangi; and, later, to the daughter, Paparauwhare, of Hinewhatihua by a former marriage. History relates that Te Ihingarangi was already a grandfather when his half-brother Maniapoto was born. This is the *whakapapa*:


(First wife) Rangianewa = Rereahu = Hineaupounamu
Te Ihingarangi
Maniapoto
Te Uehaeroa
Waerenga
Uetarangore = Hinewhatihua = Maniapoto
Maniapoto = Paparauwhare
Tutakamoana
Rora

Uetarangore was the son of Tutarawa a younger brother of Hineaupounamu, the mother of Tutakamoana and Rora have intermarried and under their *hapu* names of Ngati Tutakamoana and Ngati Rora are the most numerous of our Ngati Maniapoto subtribes with their main marae Te Tokanganui-a-noho at Te Kuiti. The writer is a member of both *hapu*.

ledge of geography and of star courses into organised bodies of data. His research provides some idea of the extraordinary quantity of information learned by qualified navigators and of the imagery employed in order to retain it in memory and to order the items into manageable inventories of knowledge.

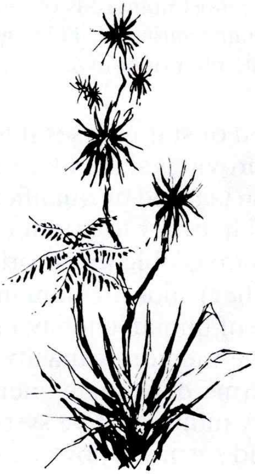
Mnemonic (and other) aids to human memory systems spanned the full range of human endeavour with the effect of expanding the effective memory capacity. This technique is well known but in terms of straight memory capacity it is difficult to imagine any multiplicative system giving a human mind more storage and retrieval power than the established computers of 1985. However, an information system at any level of Maori organisation be it *whanau, hapu, iwi, runanga* or *waka*, with well selected human repositories of information fully trained in mnemonic and other systems of memory aids and in a state of *tapu* would be difficult, if not impossible, to replicate even on our most sophisticated computers. We are told that '. . .it is the covert meaning of the fact rather than its overt and obvious meaning which is important in poetry. . .'

We could perhaps sum all this up by observing that, whereas the modern computer is variously described as:

human superhuman subhuman extra human
or inhuman

only the first of these adjectives applies to the Maori information system. It was highly decentralised and was founded on knowledge inherited from *Io* (the Supreme Being) some of which could not possibly have been shared with, or replicated by, a machine.

Maori information systems which, regrettably, are in disarray would have been, and still could be, greatly strengthened by the modern computer. In the next quarter century some of us will try to ensure that this will occur.



CHAPTER TWO

FROM MONSTERS TO MICROS

G.J. Tee

Garry Tee studied at Auckland University where he gained his M.Sc. in 1954. He is a member of the International Commission on the History of Mathematics and has published a number of papers on numerical analysis and on the history of science, including some on the Babbage family in Australia and New Zealand. He is at present a senior lecturer in Computer Science at Auckland University.

In the recent past we have seen electronic computers develop from monsters such as ENIAC in the mid-forties to the incredibly small microchip of today. But there have also been some very large and very complex mechanical calculators. This chapter gives a brief survey of both areas.

Various mechanical aids to computation have been used since the early civilisations. In China, calculations were performed by means of counting rods on squared boards from about the tenth century BC, and the modern Chinese abacus (suan pan) was developed by the sixteenth century. The Japanese soroban was standardised by decree of the present Emperor Hirohito in 1930. The soroban is still used extensively, although it is now being rapidly overtaken by electronic calculators. Comparable types of abacus were used in ancient Greece and the Roman Empire, and the Russian schyoty is still used widely.

The first major advance beyond abacus-type devices was achieved by the Scottish mathematician John Napier (1550-1617). He published his invention of logarithms in 1614 and then, despite advanced age and poor health, he set about devising further aids to computation. In the last year of his life he published a small book *Rabdologiae*, in which he described several aids to computation. The only one to become popular was his numbering rods ('Napier's bones'), which are a trivial aid to multiplication. He also invented binary arithmetic, as far as square root extraction, but he described his Promptuary as his most important idea. This is a sophisticated device for multiplication of numbers with up to ten digits each, although it still required some mental arithmetic to handle carried figures.

The first known automatic calculating machine, in which carries were handled mechanically, was constructed by the German theologian and astronomer Wilhelm Schickard (1592-1635) in 1623. His machine added and subtracted numbers with up to six digits each, but unfortunately it remained little known.

Other machines were built by the French mathematician Blaise Pascal (1623-1662) in 1642 and the universal genius Gottfried Wilhelm Leibniz (1646-1716) in 1672, Pascal's machine aroused very widespread interest, for demonstrating that some actions which had been regarded as characteristic of human reason could also be performed by a machine. Pascal appears to have sold forty or fifty such adding machines – but they were intellectual curiosities rather than practically useful calculating machines.

The first commercially successful calculating machine, the Arithmometer of Thomas of Colmar, was manufactured in Alsace. He constructed the prototype in 1820, and a few thousand were produced. The Arithmometer is much less sophisticated than Leibniz's machine of 1672, but it can perform the four arithmetic operations, and imitations continued to be manufactured until the 1920s.

A major advance in the theory and construction of calculating machines was made by the English mathematician Charles Babbage (1791-1871). He made a detailed study of mathematical, astronomical and navigational tables, and the many errors which he found stimulated him to invent his first

Difference Engine in 1821. That was a multiple adding machine designed to compute and print tables. He worked on the Difference Engine from 1822 to 1833 when government support ceased and the one-tenth of the Difference Engine which he assembled in 1833 was a technological triumph, which still works perfectly.

In 1834 Babbage went far beyond the concept of the Difference Engine by inventing the first version of his Analytical Engine. He developed that concept in a prolonged creative frenzy, and by 1836 his designs included all of the fundamental components of general computers – input and output devices, control, store and mill for arithmetic operations. He adopted punched cards as the principal medium for input, output and storage, but he also designed printing, typing and curve-drawing mechanisms. The instructions were to be supplied as chains of cards, with provision for conditional branching; so that his Engine was indeed a computer, and not just a calculator. By 1836, Babbage realised that such an Engine was not confined to arithmetic, but could be used as a general symbol manipulator. He considered many possible bases for arithmetic, but settled upon decimal arithmetic as the most convenient for use in a mechanical computer.

In 1833 Augusta Ada Byron (1815-1852, later Countess of Lovelace), then aged seventeen, visited Babbage with her mother and was profoundly impressed by him and by the fragment of the Difference Engine. Babbage had recently suffered the deaths of his wife, several of their children and his father, and Ada became a substitute daughter for him. In 1842 Ménabréa, who later became Prime Minister of Italy, published a brief but clear report of Babbage's ideas on programming the Analytical Engine. Ada was persuaded to translate that paper from French to English, and then at Babbage's suggestion she added notes which were several times as long as the original. Her paper was published in 1843 and it remained (until recent years) the fullest published account of Babbage's ideas. After that scientific triumph Ada's health collapsed, and Babbage was profoundly affected by her death, in tragic circumstances, at the age of thirty-six. In recent years she has become renowned as the patron saint of computer programming.

Babbage designed a succession of Analytical Engines from 1834 to 1848, and from 1856 onwards he attempted to construct simplified versions. However, he had not succeeded in completing more than some fragments before he died on 18 October 1871 at the age of seventy-nine. He was largely forgotten after his death.

Babbage's youngest son Henry Prevost Babbage (1824-1918) attempted to continue work on the Analytical Engine. In 1879 he assembled six fragments of the Difference Engine; and in 1910 he completed the construction of the arithmetic 'mill' and printing mechanism, for the Analytical Engine.

During Charles Babbage's lifetime the British Museum refused to accept the fragments of his incomplete Engines, which he had recommended to be displayed there. However, the Science Museum in London now displays some fragments of Babbage's Engines amongst its greatest treasures.

New Zealand too has its Babbage connections. Charles Babbage's two elder sons migrated to South Australia in 1849 and 1851, and many descendants now live in New Zealand and Australia. Some of them have large collections of relics of Charles Babbage, including many hundreds of letters and other documents, portraits, books, diplomas, medals et cetera. In particular, the Babbage family in Auckland hold one of the six fragments of the Difference Engine assembled in 1879, and two letters from Augusta Ada to Babbage. Several museums and libraries hold further Babbage material; the Babbage Collection at the Wanganui Regional Museum includes the manuscript of Charles Babbage's remarkable memoir *Passages from the Life of a Philosopher* (London, 1864), the Reed Collection of rare books and manuscripts in Dunedin Public Library includes ten letters from Babbage, and the George Grey Collection in Auckland Public Library includes three letters from Babbage to his younger friend Sir George Grey.

The first working Difference Engine was completed in 1853, by the Swedish publisher Georg Scheutz and his son the engineer Edvard Scheutz. It was much smaller than Babbage's very ambitious design, but it did work fairly successfully, printing some mathematical and actuarial tables. The Scheutzes were advised not to exhibit their machine in England, since it might have provoked Babbage to quarrel with them. But on the contrary, Babbage behaved with noble generosity to the Scheutzes, who stayed as guests at his home in London. He wrote articles and gave speeches about the Scheutz Difference Engine, and arranged for gold medals and other honours to be awarded to them. The Babbage family in Auckland hold secretarial copies of letters written by Georg and Edvard Scheutz, warmly thanking Babbage for his truly noble efforts on their behalf.

Later, a few other Difference Engines were made. In contrast to such digital calculators, which give exact results, there were developed a wide variety of analogue calculators, whose results are limited in accuracy by errors of measurement. Six years after John Napier published his book on logarithms, Richard Gunter produced an analogue device for approximating multiplication and division. Scales of logarithms were engraved on rules, so that physical addition of lengths corresponded to addition of logarithms, and hence to multiplication. Such slide rules were used very extensively, until the development of electronic pocket calculators.

The Scottish physicist William Thomson (later Lord Kelvin, 1824-1907) invented in 1880 his differential analyser, a mechanical analogue computer for modelling physical processes. Variable quantities were represented by rotations of shafts, and those rotating shafts could be connected by mechanical devices for addition, subtraction, multiplication (by a constant) and integration. The first practical differential analyser was made by the American scientist Vannevar Bush, at Massachusetts Institute of Technology in 1930.

The English chemist Douglas Hartree got a demonstration model constructed from Meccano parts, at the University of Manchester in 1934. That model proved to be practically useful, and several other differential analysers were subsequently made from Meccano parts. The second such Meccano machine was made at Cambridge in 1935, for the chemist Lennard-Jones. In 1948 the radio-physicist Dr Harry Whale from Auckland University College was on leave at Cambridge University Computing Laboratory. He persuaded the New Zealand High Commissioner to buy that Meccano differential analyser for one hundred pounds, and for several years Dr Whale used it in his research on radiophysics at Auckland University College. That second Meccano differential analyser is now displayed at the Museum of Transport and Technology in Auckland.

It would have been surprising if all this activity on computers and computing had not had an impact on the workforce, and indeed it did. The first significant use of automation in the manufacturing process came as early as about 1730, when the French mechanic Falcon invented a loom controlled by punched cards, which proved to be moderately successful. At the end of the eighteenth century the French engineer Joseph Marie Jacquard improved Falcon's loom greatly, so that extremely intricate fabrics could be woven under the control of punched cards. Jacquard looms were used very extensively; and indeed some are still operating in New Zealand.

Punched cards, of course, went on to bigger and better things. By 1880, the United States Census Bureau had found that conventional methods were inadequate for processing their census data, and the Bureau arranged a competition for new techniques to be used for the 1890 census. The contest was won by Herman Hollerith who applied cards punched with simple binary data, with electrical machines for counting holes on cards and for sorting cards according to those holes. Hollerith's system was very successful in processing the United States census for 1890 and 1900, and the Russian census for 1897. Many governmental and commercial organisations thereafter used punched card machinery for statistical and accounting work. For example, in 1929 New Zealand Railways installed an advanced punched-card system for its accounting. During the first half of the twentieth century a great variety of machines were manufactured to punch and print decimal data on cards, and later alphabetic and other characters. Machines were used to add and subtract decimal numbers on cards, and by the 1930s machines could multiply numbers on cards.

We have almost reached the end of the mechanical calculator saga, but before leaving there are two further New Zealand connections worth mentioning.

The first concerns a New Zealander whose achievements are much neglected. Leslie John Comrie was born at Pukekohe in 1893, and he graduated M.A. (with honours in Chemistry) at Auckland University College in 1916. From 1925 until his death in 1950 he was the undisputed world leader in scientific computing. He did not invent new computing machinery, having taken heed of Babbage's difficulties, but he devised ways to exploit commercially available calculating machinery for scientific computation. In 1926 he became Deputy Director of the Nautical Almanac Office at Greenwich, and in 1930 he became its Director. He invented the first computing laboratory, producing the Nautical Almanac by punched-card machinery designed for accounting work.

In 1930 Comrie discovered that a National Accounting machine could be perverted to purposes never intended by its makers, and misused as a Babbage Difference Engine. Thereafter he applied Babbage's ideas, using such machines to print mathematical tables of quite unprecedented accuracy; and conversely he used Difference Engines to detect an enormous number of errors in existing tables. In 1938 he founded the Scientific Computing Service Ltd in London, as the first computing agency. Through that firm he had immense influence on the development of scientific computing, and many scientists were inspired by him to create computing laboratories in Europe and the United States. Comrie's firm is still operating in London.

The second concerns two New Zealanders. In 1879 a Mr Ekberg patented a multiple adding machine, for use at racecourses. As each customer placed a bet, the operator pressed a pedal to add that bet into an accumulator for the chosen horse, and also into an overall accumulator for all horses. A clerk then used logarithm tables to calculate the dividends.

Within months, such totalisators dominated racecourse meetings throughout New Zealand and Australia. Indeed, before the end of the 1880 season, two operators of a totalisator were serving gaol sentences, after having been detected in attempts to cheat their customers! The Museum of Transport and Technology in Auckland displays such a foot-operated machine.

George Julius (1873–1946, later Sir George), son of Archbishop Julius, graduated as B.Sc. from Canterbury University College in 1896. He spent most of his career in Australia, founding CSIRO in 1926 and remaining its head until 1946. In 1908 he invented an automatic totalisator and his firm Automatic Totalisators Ltd built the first such automatic totalisator in 1913, at Ellerslie Racecourse in Auckland. That machine accumulated bets on up to thirty horses and recorded the overall total, with thirty input devices operating independently. The early models were entirely mechanical and were operated by the muscles of the operators pulling levers to issue tickets, and logarithm tables were still used to calculate the dividends. Later models incorporated an increasing amount of electrical operation, with division mechanisms for computing the dividends.

By the 1960s some electromechanical totalisators accepted input from 400 independent devices operating asynchronously. Such machines were not merely physically the largest calculating machines built by then, but they did have quite substantial computational capacity. Not until the late 1960s did electronic computers begin to supplant electromechanical totalisators; and Julius's firm still dominates that curious industry. It is interesting to reflect that probably the largest mechanical calculators ever to be built will have been used in a sporting activity.

The chief impetus for the development of electronic computers came from the desire to break German ciphers and the construction of ballistic tables.

In the 1920s a German firm began manufacturing ENIGMA machines, for enciphering and deciphering messages. ENIGMA contained adjustable drums for setting the cipher key, such that almost ten billion different cipher keys could be used; and hence the German Government felt that messages sent through ENIGMA were quite secure against decipherment. Accordingly, German military and governmental messages were broadcast openly in ENIGMA ciphers, and hence monitors were able to record the enciphered messages.

In 1932 the Polish General Staff engaged three mathematicians, Marian Rejewski, Jerzy Rożycki and Henryk Zygalski, to work on the ENIGMA ciphers. Mathematical logic was developed very largely by Polish mathematicians between the two World Wars; and Rejewski and his colleagues succeeded in cracking the ENIGMA ciphers by applying mathematical logic. In 1938 six electromechanical devices, called 'Bombas' were designed and constructed to assist them in finding ENIGMA keys. Those 'Bombas' were probably the most complicated machines that had ever been constructed by then. The Nazi plans for the conquest of Poland were learned from deciphered ENIGMA messages, and accordingly in July 1939 the Polish intelligence agency passed all information about ENIGMA to the British and French intelligence services. The three mathematicians were evacuated to southern France and then to England, and all traces of the work done in Poland on decipherment of ENIGMA were destroyed. Hence, the Germans continued to broadcast ENIGMA messages openly.

On the basis of that Polish work, the British intelligence service created an institution at Bletchley Park, which succeeded in deciphering enormous quantities of German messages, including Hitler's dispatches to his generals. That entire project was kept totally secret until 1974, yet the limited information released by the British Government since then indicates that Bletchley Park was one of the most important aspects of World War Two.

Bletchley Park owed much to the English mathematician

Alan Turing (1912-1954). He made a major contribution to mathematical logic in 1936 when he postulated a very simple type of machine for manipulating symbols. In modern terms, he showed that any calculating device with a conditional branching facility (an if-statement), and with potentially unlimited storage, is a completely general computer, capable of performing any well-defined transformation of symbols. He also proved that no program could possibly perform certain hypothetical types of computation. Turing's work has had much influence on later development of computer hardware and software.

At Bletchley Park from 1939 to 1943, Turing led a team of scientists who extended greatly the Polish work on the mathematical analysis of ENIGMA ciphers, and who constructed very elaborate electromechanical devices to assist in that task. In 1945, at the National Physical Laboratory, he designed, in remarkably full detail, a very powerful electronic computer which he called ACE (Automatic Computing Engine). COLOSSUS, now generally regarded as the first true electronic computer, also grew out of Bletchley Park activities. In 1943 the German military command began using the Geheimschreiber, a machine much more advanced than ENIGMA, for enciphering their messages. At Bletchley Park the mathematician M.H.A. Newman and the engineers T. Flowers, S.W. Broadhurst and W.W. Chandler designed an electronic machine, enormously larger and more intricate than any attempted previously, to crack the new ciphers. The engineers accomplished miracles to get the first COLOSSUS working in December 1943. COLOSSUS had 1,500 thermionic valves, and it read paper tape at 5000 characters per second! (When the reader was tested at 7000 characters per second, shreds of paper tape got embedded in the walls.) That first COLOSSUS was immensely successful in cracking the German ciphers.

In the United States two differential analysers had been installed at the Moore School of Engineering at the University of Pennsylvania in the 1930s. By 1942, those analogue computers could no longer cope with United States Army demands for artillery tables. The physicist John Mauchly and the engineer J. Presper Eckert proceeded to design electronic replacements for various mechanical parts in order to speed up the operation; and they wound up by constructing a purely electronic digital computer with no moving parts at all (apart from a card reader and card punch).

The resulting Electronic Numerical Integrator and Computer (ENIAC), which operated from 1946 to 1955, was an incredibly ambitious machine. It occupied a large hall, it contained well over 19,000 thermionic valves, and it used over 200 kilowatts of power. Yet had storage capacity for only twenty variables, each of ten decimal digits, plus a few hundred constants set by hand-operated rotary switches. ENIAC was not programmed in the modern sense of the word, since it had been designed to emulate mechanical differential analysers. Rather, it was set up for any specific computation by the very laborious method of connecting conducting cables between thousands of sockets.

ENIAC was triumphantly successful – anything done by a mechanical differential analyser could be done by ENIAC in a thousandth of the time, and to much greater accuracy. Moreover, ENIAC was not only a digital electronic calculator, but it had evolved into a general-purpose computer with conditional branching facilities, and with potentially unlimited capacity available through punched cards.

In July 1944, the ENIAC team decided to start designing EDVAC, as a very much more powerful machine to succeed ENIAC. Late in 1944 they were joined by the eminent Hungarian-American mathematician John von Neumann (1903-1957), and he crystallized the various ideas for EDVAC into the concept of a general-purpose computer. As with Babbage's design of 110 years previously there were a control device, input devices, a store, an arithmetic unit and output devices. Moreover, the store could contain the program to be executed, as well as numerical data (as in Turing's paper of 1936). In order to operate at high speed, the computer should be made from electronic components. Almost every computer built since ENIAC has conformed to this general pattern, known as the von Neumann type computer.

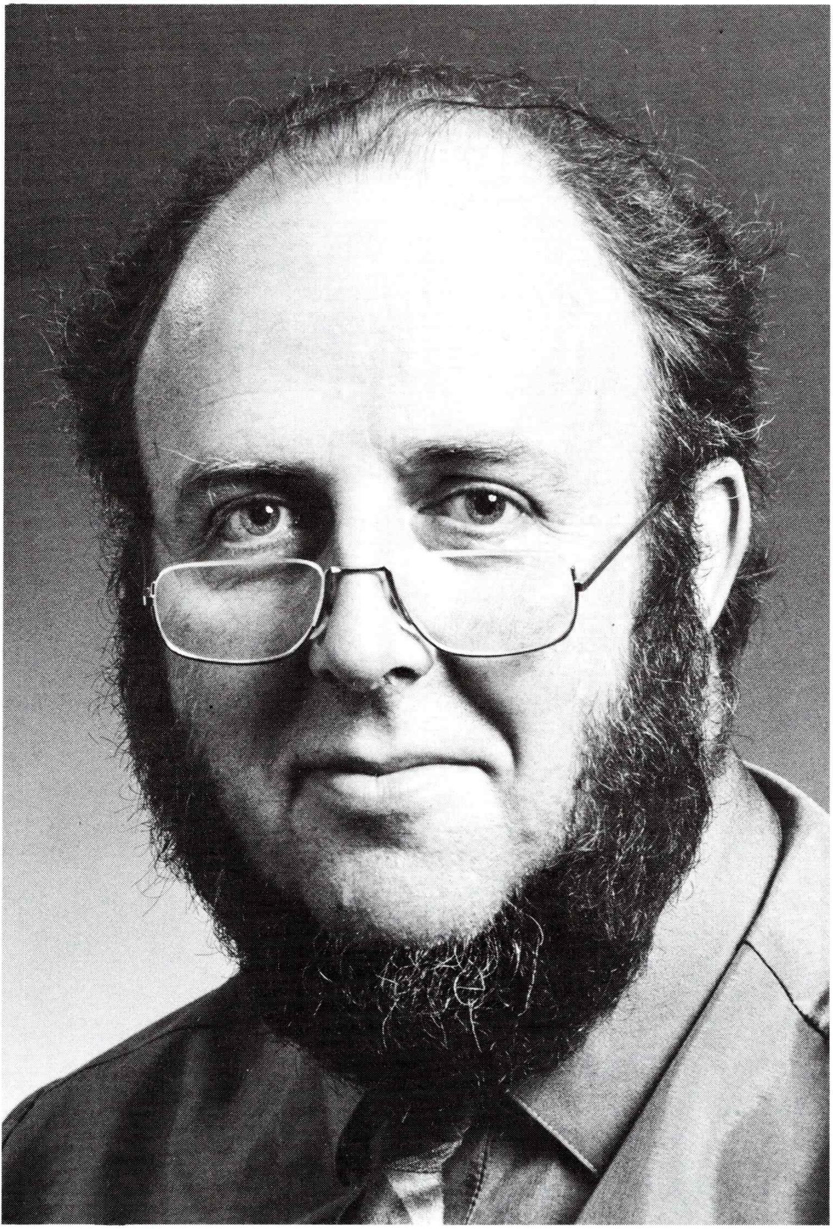
In 1946 the plans for EDVAC were effectively publicized through a series of lectures given at the Moore School of Engineering. By the time that EDVAC eventually became operational in 1951, several stored-program electronic computers had been constructed in England, Australia and the United States.

The first stored-program electronic computer to operate, (apart from an extremely small test model at the University of Manchester) appears to have been the EDSAC, made by Maurice V. Wilkes and his colleagues at Cambridge University. Wilkes had attended the Moore School lectures in 1946, and he designed EDSAC as a simplified model of EDVAC. EDSAC stored 512 35-bit words in mercury delay lines, it incorporated about 3000 thermionic valves, and it used a paper tape reader and punch. EDSAC provided a scientific computing service very successfully, from May 1949 to July 1958. A particularly valuable part of the EDSAC laboratory was the library of mathematical sub-routines developed by Wilkes, David J. Wheeler and Stanley Gill, which had been very thoroughly documented.

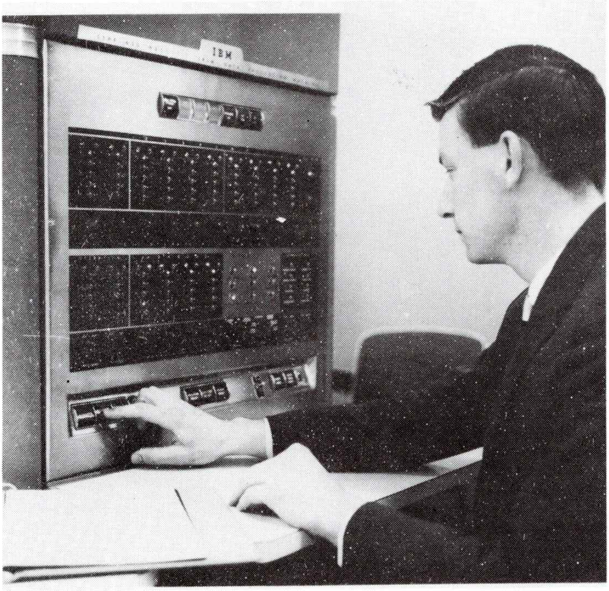
The development of EDSAC had been supported by the English catering firm of J. Lyons & Co Ltd; which operated the chain of Lyons Tea Shops. The LEO computer, a commercial version of EDSAC, began doing clerical computing for J. Lyons & Co Ltd in 1951. That was the first recorded use of a commercial data-processing computer, the forerunner of the many thousands in use today.

In most forms of technological innovation, once the new technology has become established, its scale has grown exponentially with time, typically doubling about every ten to twenty years. After several such doublings the technology has usually settled down to a steadier state, or even started to decrease, as with railways.

For computers, the doubling period has typically been about two years, not twenty! That estimate applies to most aspects by which merit can be measured – for example, cheapness, speed, capacity, compactness, reliability, convenience

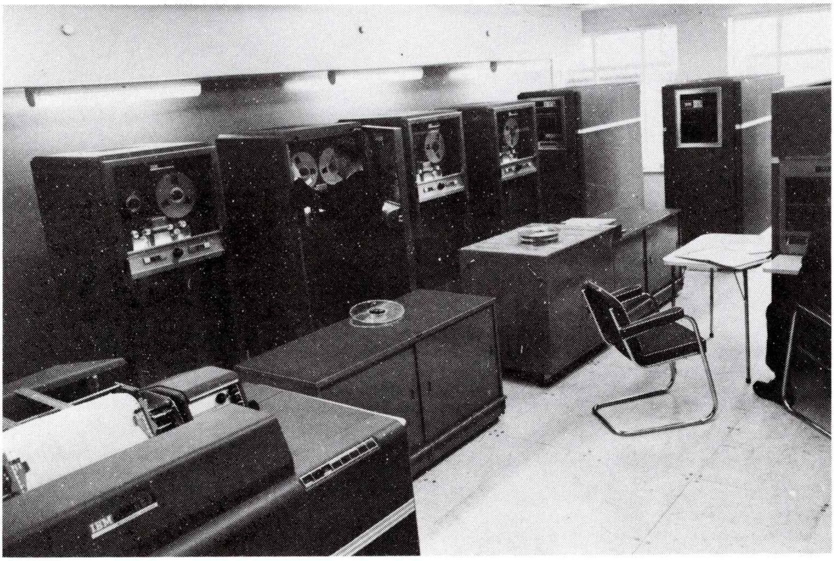


Dr C. R. Boswell, MNZCS. President of the New Zealand Computer Society since 1983.



New Zealand's first computer. Mr Don Hay sitting at the consol of the IBM 650 in the Treasury Offices, Stout Street Departmental Building, Wellington 1961.
(*Photo: Evening Post*)

A general view of the first Treasury installation.
(*Photo: Evening Post*)



and economy of operation. This growth shows no signs of settling down to a steadier state: rather, during recent years, the doubling period has tended to decrease to about 1.5 years.

About forty years have elapsed since the era of COLOSSUS and ENIAC, when computer technology became established. Accordingly, computer technology has been developed through about twenty doubling periods – giving a factor of approximately one million. And indeed it can plausibly be asserted that current computers are about a million times as good as the earliest specimens. Many readers will own microcomputers which are many times as powerful as COLOSSUS or ENIAC. No end to that progress can yet be seen, as long as humans are available to assist computers in designing and constructing the next generation of computers.

But perhaps we should give someone who spent not a little of his time in New Zealand the last word. In the early 1860s Samuel Butler, living in his hut on Mesopotamia sheep station by the upper Rangitata River, was studying Charles Darwin's *The Origin of Species* (London, 1859), and he wrote a series of Darwinian essays which were published in *The Press*, in Christchurch. Those essays evolved into *The Book of the Machines*, which forms the core of *Erewhon* (London, 1872); the major literary and philosophical work written, partly at least, in New Zealand.

In *The Book of the Machines*, an Erewhonian philosopher considers the implications of humanity's dependence upon machines.

> It can be answered that even though machines should hear never so well and speak never so wisely, they will still always do the one or the other for our advantage, not their own; that man will still be the ruling spirit and the machine the servant . . . so that instead of being likely to be developed into a higher kind of life than man's they owe their very existence and progress to their power of ministering to human wants, and must therefore both now and ever be man's inferiors.
>
> Are we not ourselves creating our successors in the supremacy of the earth? Daily adding to the beauty and delicacy of their organization, daily giving them more skill and supplying more and more

> of that self-regulating, self-acting power which will be better than any intellect?
> This is all very well. But the servant glides by imperceptible approaches into the master; and we have come to such a pass that, even now, man must suffer terribly on ceasing to benefit the machines..
> Complex now, but how much simpler and more intelligibly organised may it not become in another hundred thousand years? or in twenty thousand? For man at present believes that his interest lies in that direction; he spends an incalculable amount of labour and time and thought in making machines breed always better and better; . . .

As we contemplate the future we can be sure that Butler's time span is going to be considerably shortened. But this is leading us into areas to be looked at in later chapters of the book. Let us leave it there for the moment.

CHAPTER THREE

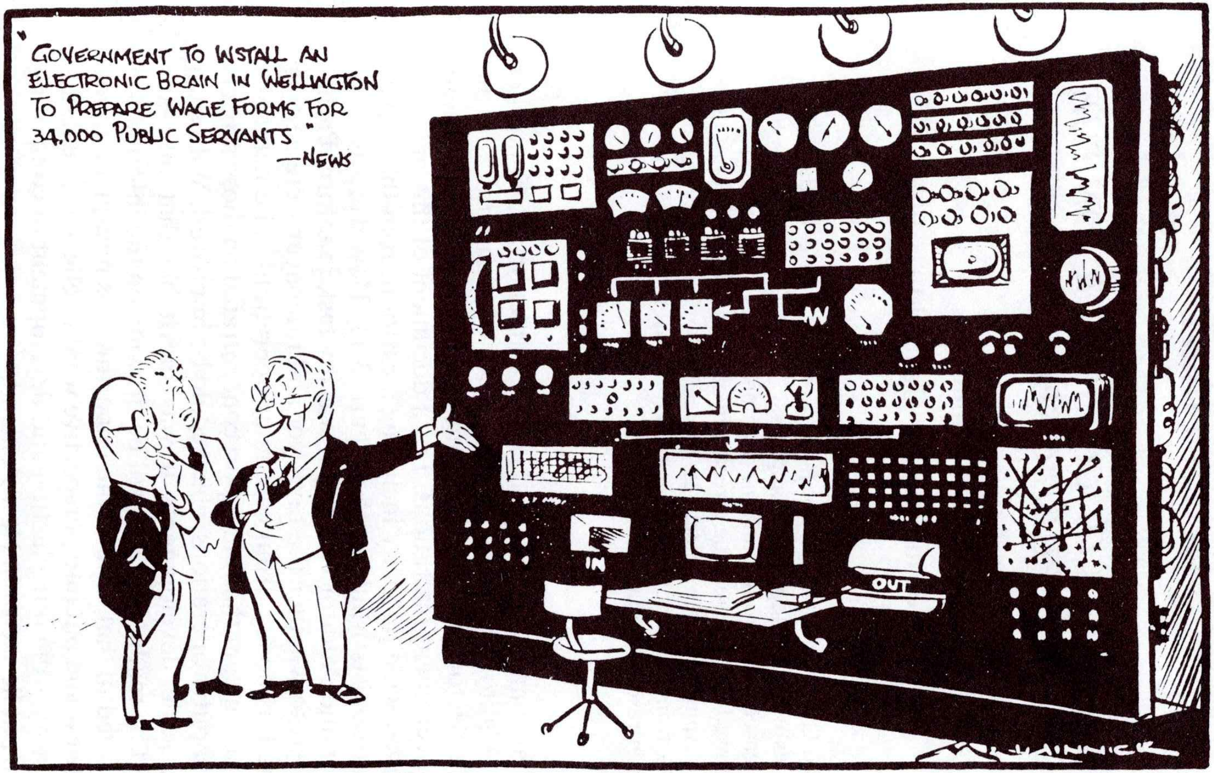
THE IMPACT OF COMPUTERS ON THE PUBLIC SECTOR

A.C. Shailes

Controller and Auditor-General 1975-1983

> The Government could not perform many of its essential functions without the use of computers. The use of computers has released staff from mundane administrative support tasks and allowed them to become directly involved in achievement of the government's main objectives. It is clear that direct financial savings from computers have recovered the overall cost of all computer resources many times over.

That comment, contained in my 1980 report (as Controller and Auditor-General) on 'The Use of Computers in the Public Sector' perhaps best sums up the impact of computers on government operations. For a document of this nature it received wide publicity including a cartoon from that doyen of cartoonists Minhinnick (Figure 3.1). However, as Controller and Auditor General it was my task to inform Parliament as to whether the taxpayer and ratepayer were getting 'value for money' from computer operations. The nature of that task meant that the report concentrated on those aspects of computer operations which could be improved. With such large scale developments it was inevitable that mistakes would be made. Whilst I will be drawing on the information contained in that report, the opportunity is now given to me to review and put into perspective what I believe is a real success story – the introduction and development of computing in the public sector in New Zealand.


"GOVERNMENT TO INSTALL AN ELECTRONIC BRAIN IN WELLINGTON TO PREPARE WAGE FORMS FOR 34,000 PUBLIC SERVANTS"
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"It's called the Computer-General and takes precedence over the Auditor-General."

In 1960 the year the New Zealand Computer Society was established, computing was introduced into the New Zealand public sector. Indeed it can be said that not only did computing in New Zealand start in the public sector but for the past twenty-five years the public sector has been the leader, and the driving force behind computer development in New Zealand. Today approximately forty percent of the business of the major computer firms is with the public sector. All this is not surprising, given the size of operations in the public sector compared to private enterprise.

Central Government was first to introduce computing into New Zealand when the Treasury installed a machine in 1960. During the next decade computing grew as an individual departmental function. By 1969 nine departments had computers, with Treasury, the Departments of Education and DSIR acting as bureaux for other departments. In 1970 it was decided to centralise the two bureaux operations, together with the Statistics Departments data-processing staff, into a government computer centre. This was initially set up as part of the Department of Internal Affairs with the State Services Commission handling the management and policy functions. In 1972 the operating and policy functions were merged to form the Computer Service Division of the State Services Commission.

No review of the development of computing in New Zealand would be complete without highlighting the introduction of the first major computer. The Treasury had been using mechanical accounting methods since the 1930s to cope with the large volume of work to be processed. However in the 1950s it became obvious that existing machines would need to be replaced if overall efficiency of Treasury and departmental accounting was to be improved.

By the late 1950s electronic data-processing systems had made much progress overseas. Treasury had been following these developments and in May 1957 IBM Australia submitted to Treasury its proposal for the installation of an IBM Type 650 Data Processing Centre. This proposal was accepted by the government in 1958, installed in 1960 and officially opened by the Minister of Finance The Hon. H.R. Lake on the 23 March 1961.

The computer system installed in the Treasury made available for the first time in New Zealand the speed and versatility of a stored programme machine using magnetic tape. The biggest single job initially undertaken was the payroll preparation of some 34,000 public servants. The computer worked out all entitlements, calculated tax and superannuation deductions, and stored the results on magnetic tape as a permanent record of the amount of pay due until an amendment was made. Each fortnight the tape record was used to print the pay vouchers and produce punched-card cheques as required for all pay points, together with coin analysis as required. Other essential records such as year-to-date totals and deduction statements were also prepared as part of the pay run. It is a tribute to these initial pioneers, and to those who followed, that for the past twenty-five years public servants have never missed being paid on due date.

But the introduction was not without its hiccups. As a Treasury officer at that time, I can well remember the upheaval caused by the installation of the new machine. As the machine was stated to generate as much heat as eighty-one bar electric heaters, an air conditioned room had to be provided, with a dummy floor to take the cables connecting the machinery. Standby generating equipment was also needed. In its initial stages the machine broke down frequently and it was only stalwarts like Paul Walker or Laurie Peko who had the magic touch necessary to get operations going again.

One must also pay tribute to the policy advisers and decision makers at that time. Little or nothing was known about electronic data processing and it took considerable courage to put their trust in a machine and abolish tried and tested clerical procedures. But senior Treasury officials were convinced that computers were here to stay, and their foresight has been amply justified during the past twenty-five years. The Controller and Auditor General at that time, in commenting on the computer introduction stated:

> That these modern accounting methods are a far cry from those employed in the days of King Henry 1, when the King's finances were controlled by a small group of administrators selected from the baronage and the clergy. This body constituted the Exchequer, so called from the chequered tablecloth used to facilitate the counting of money.

During the 1960s computer installations continued to increase and by the end of the decade nine departments had computers, with many others using the Treasury and Education Department installations as bureaux. The government applications now covered the public accounts and central pay system, accounting systems of trading departments, and other systems processed on departmental equipment in Social Security, Post Office, Railways, DSIR and Ministry of Defence. However, it was becoming apparent that one means of obtaining the maximum benefit from E.D.P. was the pooling of resources to form a bureau to serve all. This was particuarly apparent with local bodies, where such a move would avoid separate expenditure on sophisticated accounting machines that would undoubtedly exceed the individual contribution required to a joint bureaux.

I will be discussing local body developments later but the principle of pooling resources was recognised by the government, in establishing in 1970, the Government Computer Centre to centralise most government data processing. During 1970 the electronic data processing, conducted by the Treasury and certain other Departments, was transferred to the Government Computer Centre, an independent unit within the structure of the Department of Internal Affairs. The centre took over the Treasury and Education Departments' computers and also acquired an additional one. It provided all facilities, i.e. system design, programming, data preparation, and computer processing for most government departments. Policy was subject to the control of an interdepartmental committee, the E.D.P. Co-ordinating Committee, chaired by the Chairman of the State Services Commission. However, in June 1972 the government decided that the State Services Commission should assume responsibility, not only for policy, but operation of the Government Computer Centre, and to facilitate this, established a Computer Services Division, responsible to the Chairman of the Commission. This new division was now responsible for carrying out all data processing for government departments except the Ministry of Defence, Post Office, and Ministry of Works which retained their own organisation and equipment.

The Computer Services Division has now developed into a highly centralised operation, running four large computer centres and four data preparation centres. The Ministry of Works and Development Computer is now owned by the State Services Commission but operated by the Ministry as a specialised engineering facility. Other large independent installations are operated by the Post Office, Department of Health, New Zealand Railways Corporation and Ministry of Defence. All these installations have data communications networks, some of which are extensive. Several other departments have small computers, some linked to the main C.S.D. computers.

Widespread use of computers in the public sector has only occurred during the past ten years or so, but in that time there has been rapid expansion in the use of computing and consequent increases in expenditure and the number of staff employed. Today the public sector employs some 3000 data processing staff, approximately a quarter of New Zealand computing personnel. The Computer Services Division itself (450 staff) has an enviable record of success and is now recognised within government, in the private sector and internationally, for its achievements. The Computer Services Division:

Advises government on computing matters and on new developments.

Reports to government on departmental proposals and other submissions.

Co-ordinates electronic data processing in the the public service by maintaining the C.S.D. as an operating division, by performing central purchasing activities, by emphasing strategic planning, and by insisting on adherence to a standard

methodology for managing projects.
Provides electronic data processing services, including full application, design and development skills, support services and local and remote computing facilities.

The basic aim pursued by C.S.D. is to ensure that the effective and efficient utilisation of all their resources will result in a reduction in the cost of public administration to the New Zealand Public Service. However, its two primary functions of 'control' and 'service' are coming under increasing scrutiny. In my 1980 report it was recommended that the control function of C.S.D. be separated from the operation and the advisory role, either by a separate operating division within the State Services Commission, a separate agency, or a Government Services Department combining processing operations with other service functions. The tasks of initiation, evaluation, decision and implementation of all or even the majority of departmental computing projects is possibly beyond the capacity of any one organisation. It is indeed gratifying to note that the State Services Commission is undertaking a further review of its computing operations.

Each major computer installation provides services for its own sector of government operations. The Vogel Computer Centre is operated by the Ministry of Works and Development as a service for the engineering and some of the scientific work of all government departments. This operation is under contract to the State Services Commission. The ability the computer gives – enabling more alternatives to be considered in depth – is a valuable one, both technically and economically. Increasingly tasks have more constraints and complexities, and computer support is essential if feasible solutions are to be found. Facilities have been extended to give on-line support and national coverage for technical offices of the Ministries of Works and Development, Energy, Post Office, Broadcasting Corporation of New Zealand, Department of Scientific and Industrial Research, Railways Corporation and Forest Service.

It is worth considering in a little more detail the use that has been made of the Vogel Computer by the Ministry of Works and the Electrical Division of the Ministry of Energy. I consider that this is where the real value of the use of a computer can be readily understood and demonstrated, often with spectacular savings. It is also worth recording that this is the area where the government spends substantial amounts on capital construction each year. I have no doubt that computer applications in other areas have been equally successful but these are often more difficult to quantify.

The objective for the use of computers in the Ministry of Works' technical activities is an improved final project, not a cheaper, faster or simpler technical process. In most cases the cost of the use of the product is at least ten times the cost of construction, which in turn is at least ten times the cost of the design process. (e.g. Figures from the New Zealand Year Book show the expenditure on petroleum and motor vehicle imports to be approximately twelve times the expenditure on roading.) Design processes generally involve analysis, information handling and technical judgement based upon experience and intuition. In this the particular abilities of both the professional and the computer are required and these are generally complementary. Here the computer is a tool giving the user the opportunity to gain a wider and more accurate understanding of the problem and the ability to test the effect of different solutions.

The development of computer support in the Ministry was vested in a Computer Services Section set up in 1966 from the Systems Laboratory, Central Laboratories and the Machine Accounting Section from the Accounts Division. Program development was started and in the late 1960s a new computer installation was established in the Vogel Building. This machine was initially shared with engineers from the then New Zealand Electricity Department. Today surveys show that the economic return from the use of this computer outweighed by a factor of at least eight to ten the cost of the computer and its operation.

Here are three examples, the first from Power Canal Design. The Hydro-electric power stations in the Upper Waitaki Power Scheme are supplied with water by canals.

This means that the time water takes to flow from the inlet to the station and the surges that accompany rapid changes in generation must be accommodated within the canal. Accurate prediction of the water surface is only possible by computer. Such predictions save unnecessary embankment costs and also allow station operation rules to be set up that give the most efficient performance for the generating system. Such rules were set up for the stations in this scheme and are producing ongoing benefits of over $2 million per annum.

Another area with high potential savings is that of selecting the optimum route for roads etc. The relocation of the State Highway between Cromwell and Clyde and associated local roads for the Clutha Valley Development Project have been designed using computer based methods. Ten alternative routes have been considered in depth where perhaps two could have been considered by manual methods. The savings in cost associated with reduced earthwork quantities between the best of the first three alternatives and that selected is $1.5 million at current contract rates.

Finally there is the case of the Mangaweka road-rail deviation. The following press statement at the time (early 1970s) still makes an interesting story –

> Delays in construction programmes usually mean vastly increased costs but in the case of the Mangaweka road-rail deviation it has meant the saving of millions of dollars. If a planned deviation had gone ahead in 1967 it would have cost about $9 million and about $11 million at the present day costs. But thanks to the Ministry of Works computer a comparable route has been found that will cost only between $6-$6.5 million. Ministry engineers using the computer have also found an alternative road route which closely follows the present road. If this route is adopted and the National Roads Board does not have to join the Railways Department on a joint road-rail deviation on the other side of the Rangitikei River it would save the Board even more. The Board's share of the cost of the original $11 million proposal would have been about $6 million and about $3.5 million of the $6-6.5 million plan. But if the Board goes it alone it will only cost it between $1.7 million and $2 million. Thus the computer could end up saving the Board about $4 million. The computer, which

> has been in use for little more than a year, is able to provide from aerial photographs an infinite number of trail lines which can be varied laterally or up and down. When programmed with desirable gradients and other controls the computer provides a solution which requires minimum earth works. It is impossible for engineers to get similar results using conventional methods unless they are prepared to spend decades doing surveys.
>
> Computers have come in for considerable abuse over the years but as far as the Ministry of Works is concerned the one it has is worth its weight in gold.

The other initial major user of the Vogel Computer was the New Zealand Electricity Department (now the Electricity Division of the Ministry of Energy). The design, development and forecasting areas of the Division's activities are the major users of the computing facilities provided by the Vogel Computer Centre. While detailed designs of major items of electrical equipment, i.e. generators, transformers and circuit breakers or associated mechanical items such as turbines and boilers are not undertaken by the Division's staff, a considerable amount of additional work is necessary on ancillary parts of the system to incorporate these predominantly overseas-cost components.

In the development of a power system the basic plan for future generation is dependent on the ability to forecast the country's electrical power demand for a considerable period into the future, taking into account such factors as weather, the country's general economic situation and any effects or alterations to tariffs.

Assessments of the results produced by present-day computer-aided methods compared with earlier manual methods are impossible to make accurately as the techniques currently being used could not be applied manually – certainly not without gross assumptions which would render any comparisons of doubtful value.

Power development is a typical area where investigation of alternative generation developments is greatly assisted by use of the computer, because many more combinations can be analysed in greater detail. While there are frequently other considerations which may dictate that the optimal solution is not proceeded with, these analyses provide the background information on which management decision can be made, in that the penalty of non-optimal development is known. By-products of these long term investigations are that, for shorter-term work, marginal costs of generation are obtained and also scheduling of fuel for thermal stations (coal, gas and oil) can be achieved more accurately. Forward projections of gas use are essential to tie in with overall fuel use for the Energy Plan and developments of the gas/oil resources. During the simulation of the operation of all stations for the planning period, other factors are obtained (plant factor, necessity for two-shift operation) for future stations and these details can then be written into the station and equipment specifications in the planning stage, rather than possibly having to modify multi-million dollar contracts later.

In the design and construction area the Power Project Co-Ordination Section makes use of the ICES-PROJECT sub-system for scheduling construction on the major power station schemes. It was used for Huntly Power Station and it is proposed to use it for Ohaaki. These have capital costs of $500,000,000 plus, and $200,000,000 respectively. The importance of keeping construction on schedule and the savings which can be achieved by good control of the projects can be quite considerable.

Other design areas use the computer for analysis of station earth grid design (to limit step-voltages and rise of earth potential under fault conditions), analysis of conductor catenaries for take-offs from station structures to transmission lines and analysis of strengths of structures. In addition the effect of using filters on the South Island system to limit the transmission of harmonic frequencies from the High Voltage Direct Current scheme and from the Tiwai smelter, has been modelled successfully and this application has been used on the North Island system to study the consequences of North Island Main Trunk electrification.

Moving away from the question of engineering design we come to what is undoubtedly the most well known computer installation as far as the general public is concerned, the Wanganui Computer Centre. The centre is operated by the C.S.D. for its three main clients, the Police Department, Department of Justice and the Ministry of Transport. It provides and operates, as required by the Wanganui Computer Centre Act 1976, a computer based information system to aid its three main clients in carrying out effectively their roles in relation to the law and administration of justice, at the same time ensuring that no unwarranted intrusion is made upon the privacy of individuals.

The services provided include a rapid response on-line information update and retrieval operation for over twenty-five major systems twenty-four hours a day, seven days a week. Through its 403 terminals the centre deals with 90,000 transactions a day and switches 15,000 messages a day between terminals. This centre is still expanding rapidly. For example, in 1983 Parliament agreed that the centre store information and licence details of all firearm owners in New Zealand, some 350,000 of them. The Department of Health commenced a major computer project in 1975 designed to provide all hospital boards with core computing systems. The initial proposals were for three core systems, i.e. payroll, patient admission and discharge recording, and clinical laboratory. The project encountered considerable technical and managerial difficulties, but in 1981 an agreed alternative strategy was developed under an Advisory Board. Considerable progress has been made by the Department, computing services are now provided to all but the very small boards. The co-ordination of development through a single Advisory Board has been an essential element of ensuring that duplication of effort is avoided while at the same time allowing local initiative.

Progress on the major systems are –

> Payroll – Study of other payroll systems showed that the current system best suited the needs of management. It provides personnel recording and manpower budgeting facilities and is now used by twenty boards, with probable extension to the remainder in the near future.

Admission/Discharge – This system now covers over forty percent of all admissions in public hospitals. It is seen as the base for future hospital and patient management systems.
Clinical Laboratory – Development of a national system was halted in 1980 and boards have now been authorised to proceed with development of their own systems after consultation with the Department of Health.

The Computer Service Division also maintains and operates computers at the Trentham Centre and in Wellington at the Cumberland Centre and Pipitea Centre. These centres service most government departments.

The data processing work of the Social Welfare, Valuations Departments, and the Housing Corporation are accommodated in the Pipitea Centre, whilst all of the government accounting functions, public service and teachers' pay as well as the two major insurance companies, State Insurance Office and Government Life, are catered for by Cumberland Computer Centre. Out in the Hutt Valley, Trentham's Computer Centre provides a remote processing service to a number of departments together with a major on-line transaction processing activity (known as the CASPER system) meeting the requirements of the Customs Department import entry activities. All of the C.S.D. centres have well established data communications networks which extend from Kaitaia in the north to Invercargill in the south.

It would not be possible to review all these operations here, but perhaps the activities undertaken for the Inland Revenue Department can be taken as typical.

It has been suggested that if the Inland Revenue Department wished to carry out manually what is now done by computer, it would need a staff approaching the total population of New Zealand. That is obviously an exaggeration, but the work performed at the Pipitea Computer Centre of the C.S.D. for the Inland Revenue Department is most impressive. Inland Revenue is the single biggest user of the Pipitea Centre's resources, and during the peak months of activity between April and August will process up to 140,000 transactions against the data-base each night and make 40,000 enquiries of the base each day. For example, the system records information in respect of two million tax returns each year from salary and wage earners, self-employed, companies, estates, etc., and automates the policing action in respect of persons failing to submit returns. It also:

> Calculates tax due or refunds payable from summarised totals captured from salary and wage earners returns. It automatically posts debits or credits to the ledger and produces cheque or payment demands. Suites of programs associated with this system police for payment on time, send reminder notices, and assess penalty tax.
>
> Collects PAYE instalments in most cases on a monthly basis from employers – more than $500 million per month in 20,000 transactions, including arrears, recording and policing for payment.
>
> Matches four million IR12 tax certificates from employers with four million submitted by tax payer with their returns. Levies all employers based on number of employees and the occupations they are employed in, for Accident Compensation.

It is interesting to note that the system recovers an additional $6-8 million per year from those who ‘forget’ to declare all income. It also isolates employers who have deducted PAYE but not passed on deductions to Inland Revenue. There is a large volume of routine clerical work involved in processing tax returns. Computerisation has stream-lined and speeded up the whole system, taken much of the drudgery out of the work and freed employees for more interesting and important duties.

Another large group of users of computers are the statutory boards and corporations. These cover primary products marketing boards, other statutory corporations like the Broadcasting Corporation, and wholly government-owned companies. As noted in my 1980 report, these organisations employ approximately 450 data processing staff and they possess computers valued at a fifth of the total in the public sector. Computing in statutory boards and corporations is characterised by a wide range of applications. Many are specific to the functions of the organisations. There is a number of factors which make their data processing operations more like those of commercial companies. They have experienced similiar problems to those in government installations, but they have been able to minimise the effect of these problems by use of additional resources at short notice. This may involve employing extra staff, hiring consultants, or purchasing additional hardware. This is possible as boards and corporations do not have the lengthy approval processes that exist in central government and are able to readily adjust budget allocations.

Their managers have tended, through a commercial orientation, to be more aware of the strengths and limitations of data processing. In addition, several boards and corporations have made extensive use of consultants. Their experience has generally been more satisfactory than in the remainder of the public sector. This is probably indicative of the closer relationship of applications to the commercial experience of the consultants.

The picture in the local government area is somewhat similar but the initial computing requirements of most local bodies were met by computer bureaux. The experience gained from their services and the fall in hardware costs led to a growth in facilities within organisations. Currently, the value of computers owned by local authorities represents approximately twenty percent of the total value of computers in the public sector and they range from very small, unsophisticated computers to medium-sized machines. Local authorities employ approximately 800 data processing staff.

The traditional requirement of local government has been for financial applications and the majority of effort has been in this area. Other applications include electoral rolls, libraries, scientific/engineering and port container tracking. Local government computing is not homogeneous. There is a wide range in the size of installations and marked variations in standards. This is the result of reliance on the ability of individuals within the data processing area with little top managerial direction or interchange of systems between local authorities.

In my 1982 report to Parliament, I reiterated the view that it is of benefit to local authorities to co-operate in the joint development of computer systems. While joint operation of a bureau may not now be cost-effective because of the relative cost of large mainframe computers as compared with micro computers, there is a considerable advantage in joint purchase of hardware, and joint purchase or development of software. It is pleasing to note that a number of local authorities have already participated in the joint operation or use of computers. For example, during 1981 a group was formed based in the Matamata Borough Council. Market proposals were evaluated but the group considered that best results could be achieved by having separate contracts for purchase of hardware and for custom written software. I am sure this system will provide a useful additional option to local government managers. Indeed it has grown into a group of thirty-one local bodies operating as the Local Government Computer Joint Committee. Almost all evaluations of computer proposals are now being assisted by members of the Local Authorities Computer Services advisory group.

Future computer developments in local government need to extend the use of the computer as a management tool rather than as a means for performing basic bookkeeping functions.

All the computer installations reviewed in this paper and particularly their financial applications, are subject to audit by the Audit Office. This has meant a very significant change in the modus operandi of the Audit Office in the past twenty-five years. In every case when a new computer installation is planned the client consults the Audit Office to ensure that adequate controls have been included in the programme. The Audit Office in turn has had to ensure that it can effectively play this role, and, to this end, E.D.P. auditing courses have been conducted since 1960. These courses are often attended by staff of client departments and by chartered accountants in public practice. There is no doubt in my mind that the Audit Office over the past twenty-five years has been to the forefront in New Zealand in training E.D.P. auditors.

Whilst I was Controller and Auditor-General it was always my concern that some major computer fraud would be uncovered. It is a tribute to the high skill and training of the auditors and the E.D.P. staff of our clients, that New Zealand seems to remain free from such white-collar crime, now becoming so commonplace overseas. To keep it that way we must ensure that our computer systems and controls are one step ahead of the would-be criminal.

My 1980 report on the 'Use of Computers in the Public Sector' was designed to assist clients in avoiding many of the more common pitfalls in computer installation and application. The report has been well received and most of the recommendations adopted. But we do not stand still. Readers who have persevered so far will by now realise that the writer is not a computer expert. (Indeed much of the information contained in the paper has been kindly supplied by officers of the C.S.D. Ministry of Works and Audit Department.) Most government administrators and decision makers of my generation have had to rely on advice and guidance from computer experts. Times are, however, changing. The new recruits into government offices to-day are very knowledgeable on what computers can do. They will expect and demand that they be able to use computers in their everyday work. Similarly the cost of hardware, once the main cost, is now only a fraction of the cost of the human resources needed to operate computers – a trend which will undoubtedly continue. In the short term there is a growing and widespread interest in computer based management information systems. Associated with this interest is a concern that computer systems are not in place to meet demands in this area. These demands have no doubt been created by the changed emphasis in government, emphasis on cost performance, on improved control of resource use and on a need for better reporting.

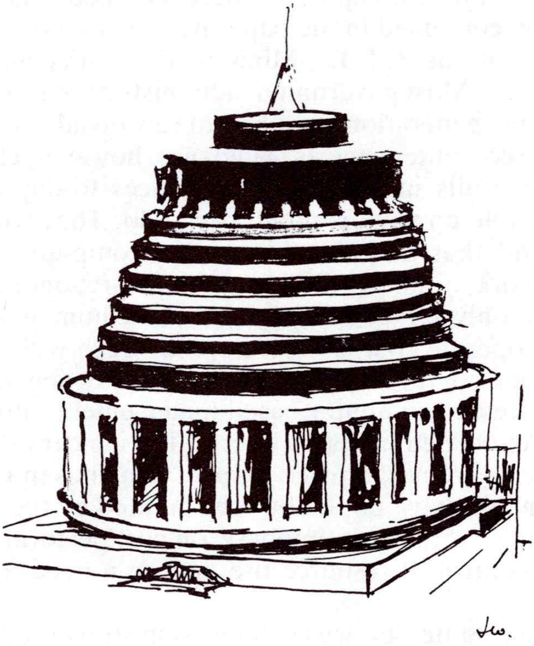
In a recent State Services Commission study on the introduction of information technology into the New Zealand Public Service the benefits perceived were:

> Improved management support and financial savings from increased efficiency. Better access to and dissemination of

information which will improve communications both internally and with the public in general.

In the next ten years managers and decision makers will have on their desks 'decision support systems' as familiar as today's telephone.

In the following fifteen years – who knows?



CHAPTER FOUR

COMPUTERS AND BANKING

I.H. Archibald

Ian Archibald came to New Zealand in 1955 and joined the staff of the Bank of New Zealand. When the bank formed its EDP Department in 1964 he was appointed as one of its first members. He joined Databank, again as a foundation staff member in 1976 eventually retiring from the post of Deputy General Manager at the end of 1982. He is at present acting as an independent consultant.

The first serious interest shown by a New Zealand bank in the use of computers occurred when the Bank of New Zealand instructed a young executive, attached to its London office, to investigate their potential for use in the banking industry. Gordon Hogg at that time knew little on the subject, but threw himself enthusiastically into a task which was to set the scene for a lifetime career.

Early in 1964 the British banks were struggling ineffectively to harness the power of the computer to help them cope with ever increasing volumes of paper, the base of the labour intensive banking system. The method employed was to punch their 'on own branch' daily transactions information on to paper tape in the bank branches. This was sent to a computer centre and used to update the bank's masterfiles. Account status changes and customer statements were printed overnight and returned to the branches each morning – assuming all went well. Unfortunately, as one might expect, such an operation was fraught with mechanical pitfalls and plagued by human error. The bulk of transactions, such as cheques drawn on other branches and other banks, were still cleared manually and reports of possible benefits from the use of computers in banking were not encouraging.

Across the Atlantic, in the United States of America, bank computing was developing on a somewhat different tack. Here they were experimenting with MICR (Magnetic Ink Character Recognition). This technique uses the somewhat stylized numbers now universally found on the bottom of cheque forms. Although only in its infancy, and beset by inevitable teething problems, the immense potential of MICR was clearly visible to a discerning eye, and the assessment was made that this was the way to go in New Zealand.

The head office of the BNZ in Wellington was sufficiently interested to authorise the setting up of a small team, tasked with analysing the implications and costs of the introduction of computing into New Zealand banking. Hundreds of unsuspecting bankers were aptitude tested and the successful few drafted into the newly constituted Development Research Department. Hardly a selection process which would be advocated in the glossy pages of the computer magazines today, and without doubt the average bank manager looked askance at some of the incumbents. But what was required was not traditional bankers. There was then no blueprint for successful business computing. Some would say this is still true today! The sign on the wall behind Gordon Hogg's desk said: 'Imagination is more Important than Knowledge'. While a bit of knowledge didn't go amiss at times, imagination was certainly required in large measure.

To spend vast sums as a matter of course on computer systems had certainly not emerged as an acceptable trend in the mid 1960s. Nor was it thought fashionable, or necessary, to keep up with the Jones's. Computers were few and far between and not usually very successful. Good hard logic, with benefits on the bottom line clearly ascertainable, was needed to convince a not surprisingly sceptical Bank of New Zealand Board that the doubtful art of computing was worth pursuing.

Decimal currency conversion was due to take place in July 1967, and this proved to be the decisive factor. While it was accepted that there was a good case for introducing computers in the longer term, a sense of urgency was introduced when it became clear that there were substantial advantages accruing to the bank through having the accounts of a substantial proportion of their branches processed by computer, prior to decimal currency conversion. Because of the requirements which had to be met before an owner qualified for government assistance in the conversion of existing machines, together with the age spread of the bank's equipment, substantial capital outlay on new decimal machines would have been needed. The advantages to be gained by spending instead a similar sum of money on introducing computers to coincide with the conversion to decimals were apparent to all.

By mid 1964 permission had been given to go out to tender for two computers, one to be located in Wellington and the other in Auckland. The objective was to use these machines to process the accounts of one hundred branches of the bank before July 1967 and thus avoid any expenditure on new decimal ledger machines. The die was cast for the arrival of computing on the banking scene in New Zealand.

Tender documents were prepared in August requiring response by November. All suppliers were dubious about the feasibility of achieving the planned target. There were no computer centres to house whatever equipment was selected, no trained system analysts, no experienced programmers, no operators, no MICR encoded documents, no data entry equipment, no facilities for handling mass computer output, and no clear understanding of many of the problems. It also became apparent that there were few computers, known to be currently available, which were capable of handling the workload within the time and cost constraints. To make matters worse the number of skilled support staff available was strictly limited and already committed elsewhere.

The debit side of the scales was heavily loaded against achievement of what seemed optimistic goals. On the credit side was unbounded enthusiasm, an enduring faith in eventual success, and a blissful ignorance of the immensity of the undertaking. Earlier in the year a faint glimmer of light had appeared on the horizon. It heralded the dawn of the IBM System 360 era. By December 1964 orders had been placed for two 360/30's, one to be located in Wellington and the other in Auckland. The battle was well and truly joined. While there were occasional eclipses of the sun, the benefit of hindsight has done nothing to dim the enlightenment of that first crucial hardware decision.

No greater contrast exists between computing in the mid 60s and the mid 80s than in the ancillary computer equipment market. Now every glossy magazine lists sophisticated gadgets. Salesmen eagerly ply their wares. In the mid 60s offerings were scanty, simple requirements to handle output from the printers such as bursters and guillotines were 'new technology'. A close study of overseas computer centres was often needed to obtain specifications for essential gear. Local suppliers with the necessary import licences had then to be cajoled into providing and servicing the appropriate devices or they had to be designed and produced in New Zealand. Improvisation was frequently the order of the day, particularly in fittings to convey paper to and from MICR voucher readers. With their capability of processing documents at 1600 a minute, the mere logistics of feeding and removing paper presented a formidable problem, and one which was not immediately appreciated.

But the fantastic throughput of exotic MICR reader-sorters was of little avail if there were no magnetic ink characters on the bottom of cheques and credits. There was no equipment in New Zealand capable of magnetic ink printing to the exacting specifications necessary for a successful reading operation. The situation overseas was not much better, the output from available printers was fully committed, the quality was questionable and, in any case, the time factor ruled out any prospect of overseas supply. It was essential to have MICR encoded documents moving into the hands of the banks' customers at least six months before start day so that unencoded paper was cycled out of the system. An Auckland publishing firm, Wilson & Horton Limited, bravely undertook the hazardous task. Bankers were seconded to assist in quality control and in the monitoring of lists of branch customers and account numbers. For those involved it was a diet of blood, sweat and magnetic ink which went on for several years. The level of print quality and saturation achieved as millions of documents poured off the assembly line was in no small measure responsible for the success of the whole operation.

The computers were due to arrive in September 1966 in Wellington, and October in Auckland. The centres to house them were to be part of specifically planned bank buildings, but construction did not commence until mid 1965. Once again it was a race against time. Twenty computer centre constructions later, the difficulties experienced seem miniscule, but then all the problems of raised floors, ducted air conditioning, humidity and dust control, and computer room fire precautions were new to builders in New Zealand. The building in Wellington was the most time critical and the third floor, which was to be used to house the computer equipment, was fully completed while the ground, first and second floors were still open to the elements. Access to the lifts had to be gained across a barrage of cement mixers, barrows and builders' supplies for months after the centre opened, but up there on the third floor the computer was humming oblivious of the carnage below.

What of the system design? Modular programming, Gane and Sarson, Jackson, and Information Engineering were unheard of. After a month on the job a programmer was an expert and regarded reverently as the fount of all knowledge. Planning charts were very much the order of the day and the walls of the programming room were soon covered with complicated diagrams depicting what was required to be done, by when, by whom, who for, and establishing with frightening clarity the volume of work and the critical path.

A start date of the Friday preceding Labour weekend in 1966 was chosen for Wellington with Auckland to follow in mid November. There was no possibility of delay as a packed schedule for bringing on branches followed tightly after start date, with no leeway if the target of one hundred branches by

July 1967, Decimal Currency Day, was to be achieved.

Programming proceeded apace. System and program specifications fell well short of present day standards. The code written was far from elegant and certainly inefficient. The bugs had a field day. But the code writers were bankers. They knew exactly what was required from the system without being told. While the computer might have to labour excessively coping with raw, inefficient code, at least the users were getting a system that catered for all their requirements. Has the arrival of the business micro seen us go a full cycle? Once again users writing inefficient code, but understanding the business problems, are into the action of producing the programs.

Bank staff involvement at this time was mainly in the numbering of accounts and in endeavouring to obtain as high a proportion as possible of MICR encoded paper. Failure to achieve the latter would mean a lot of work for branches reversing items from the unposted items account once they were on system. The daily procedures at the branch would radically alter with computer processing. Much of the work of the ledger department would disappear, but the teller clearing area would be required to master the intricacies of preparing input for transport to the computer centre. A new position was created, the MICR Controller, whose function was to supervise and monitor the work flow to and from the reader sorters located at the centre. Well prior to changeover selected staff from branches attended three day courses in Wellington. It was alleged, but never fully substantiated, that the nearby 'Purple Onion' nightclub recorded a significant increase in patronage during this period!

In the main, bank staff reacted favourably to what they learned about the new systems. They saw an end to the daily chores of balancing details, late nights to balance ledgers, the concerted efforts required at half-yearly and annual balance times, the manual calculation and applications of interest, and the embarrassment of explaining to customers the consequences of the numerous mispostings. After experiencing computer processing for a few weeks some staff may have wondered whether the cure was worse than the disease. However, once the initial learning curve was behind them and, in particular, when the bulk of the non MICR paper was out of circulation, few would have opted for a return to the tedious manual operation.

The first New Zealand trading bank branch to have its accounts processed by computer was the Vivian Street branch of the Bank of New Zealand. Balances were captured and recorded on computer masterfiles at close of business on the Thursday before Labour weekend. The method employed was quite simple. Account numbers and balances were punched on to paper tape in the bank branch, the equipment proved the check digit on the account number, and also printed the balance on an adding machine listing. Accounts were balanced manually before the data was released to the computer where the balancing process was repeated and compared with the figures extracted manually. The gear was portable and subsequently conversion teams trucked it up and down the two islands of New Zealand bringing bank branches on system.

Friday was the first day for processing transactions to the new branch masterfiles. Branch staff felt naked without the familiar sound of clanking ledger machines, and departed for their Labour Day weekend holiday more than a little uneasy, with a strong suspicion that, come Tuesday morning, the ledger machines would be back in action for a frantic effort to restore the status quo and get back up to date. The holiday weekend had been chosen to provide an extra day in case of mishaps. Every minute of it was needed – and the nights as well. The combination of adverse circumstances had prevented completion of the schedule for extended user acceptance testing. A not unknown occurrence even today! The only time the printer got beyond a mild chug-chug was when a program failed to the accompaniment of the soon familiar death rattle as the error details were printed. The job could have been done quicker with a quill pen and hand posting.

A lot was learned that weekend. By the time the branch staff arrived on Tuesday morning all was in order and few were aware of the fervour of the intervening days. Somehow processing requirements were met all through that first week. Another large branch was due for conversion on the Friday! It was absorbed without incident and from then on Wellington Centre never looked back, although it was to be many months before a program could be trusted to run through to the end without a programmer present in the computer room. The opening of Auckland caused more trauma, but this was overcome, and the impossible was achieved with one hundred branches of the bank up and running comfortably on computer by Decimal Currency Day on 10 July 1967.

As an aside, present-day programmers accustomed to almost unlimited virtual memory, real memory of up to thirty-two megabytes, and machines capable of millions of instructions a second may well wonder at what was accomplished. The 360/30s used, managed just around 30,000 instructions per second, had sixteen kilobytes of memory, three slow tapes and no disks. At one stage OS was being mooted for the operating system and Cobol for the programming language. Fortunately the Government Computer Centre, further ahead with their development on a much larger 360/40, had enough trouble running Cobol to alert bank programmers to the dangers, and force a decision to use Assembler. Machine code might have been more appropriate! For most jobs the so called Tape Operating System was used with the system resident on tape, which had to be read through on a job change until the required program was located. The main masterfile update job required three tapes so even that luxury was denied operators. A basic operating system occupying four kilobytes was used. Not really in the same ball park as the millions of bytes common place today, which somehow doesn't seem to accomplish much more. To add to the miseries the French-made tapes frequently graunched on rewind necessitating agonising reconstruction of the transaction data and account masterfiles.

Surprisingly the whole operation hung together. Customer reports were usually on time and always correct. This was due in no small measure to the enthusiasm, initative and dedication of the people involved. The programming team became known as the 'Magnificent Seven' after a current film of that name. Many worked up to twenty hours a day for months on end, while weekends and holidays were forgotten. Quite a change from todays nine to five dominated society. But not entirely, in times of stress it restores one's faith in human nature to see the old flame of enthusiasm rekindled and the different challenges of today being met with equal vigour.

In an industry processing hundreds of thousands of transactions a day, data entry was the critical function. The reader sorters were capable of reaching speeds of 1,600 documents a minute, but only a skilled operator, backed up by highly efficient support personnel, could achieve and sustain this. Many traps lay in wait for the unwary and could send thousands of documents scattering on to the floor, from where they had to be painfully reconstituted back into their original batches. On one memorable occasion two pennies, sellotaped to the back of a cheque in lieu of stamp duty, escaped preliminary detection, and went careering at thirty miles per hour into read heads and transport mechanism with spectacular results.

The control systems used were innovative. Significant use was made of the computer to produce, edit and compare control totals. Operators were provided with a series of easily checked zero balancing control points throughout the night's processing, combining control figures originating in the inputing branches and tight audit procedures were incorporated. In practice fraud and undetected errors were eliminated from the computer centres.

The sheer amount of paper was mind boggling. Around 120,000 transactions tightly banded together and assembled back to back would stretch from the try line to the twenty-two metre line. Just physically moving this through the capture/balance process and maintaining control of the flow was an achievement in itself. In those early days reject rates of around three percent were normal, which was only about a third of the then world average. Today, reject rates of between one and two percent are being handled. These have to be re-entered into the system and balanced with branch supplied figures. A tedious process you may think, and certainly a different exercise from some other types of data entry. But what other input media could provide for the immediate processing of daily volumes of between three and four million vouchers and deliver the paper neatly sorted to the drawer's branch often hundreds of miles away within thirty-six hours? Small wonder trading banks in New Zealand have been selective in moving towards electronic funds transfer when they possess the most cost effective paper moving system in the world of banking.

However, in mid 1967, only the Bank of New Zealand was involved. At a time when nine out of ten computer projects worldwide were in trouble it had a highly efficient computerised banking system which was attracting considerable overseas attention. Other trading banks in the country were investigating computer processing, a route followed by their overseas affiliates, but the geography and thinly spread population of New Zealand meant that computer coverage outside courier delivery distance from Wellington and Auckland was uneconomical for one bank.

At that point the Bank of New Zealand made the bold and far-sighted decision to offer the use of their basic system in a joint bank processing venture. Although the BNZ computer operation was running effectively, and the potential financial benefits to new participants in joining it were substantial, it still required supreme entrepreneurial skills to overcome prejudices fuelled by a hundred years of competition, and to meld together the divergent viewpoints into a basic business concept providing acceptable parameters for a viable co-operative processing enterprise.

Late in 1967 the banking consortium to become known as Databank Systems Limited was formed, with Gordon Hogg as General Manager reporting to a Board of Directors in effect representing the five participating banks. By the end of 1969 every branch of every trading bank in the country was operating under a jointly owned computer system supported by computer centres in Wellington, Auckland, Hamilton, Palmerston North, Christchurch and Dunedin.

Undoubtedly the impact on the banking industry in New Zealand has been considerable and from time to time concern has been expressed about the possible inhibiting effect on a bank's ability to compete effectively when it is a member of a consortium such as Databank. Some minimum measure of co-operation in banking is mandatory if only to agree rules for clearing, reconciliation and settlement. The spectrum from competition, or at least minimum co-operation, through to maximum co-operation is continuous. The implication of technological developments on an individual bank's policy towards competition and the impact, in turn, of competition on co-operative technology are both complex and far reaching. It is interesting to observe that overseas the sheer cost of technology required to develop sophisticated payment systems is forcing a trend towards increased co-operation. On balance in New Zealand it would appear that co-operation in basic processing systems has freed up staff to intensify competition in developing and marketing the banking products which these systems support. The existence of this competition, not surprisingly, induces strains on the co-operative aspects of the consortium and considerable ingenuity and diplomacy are required to strike an acceptable balance between co-operation and competition. In fact, this tightrope has been walked surprisingly effectively by the New Zealand banks for seventeen years.

From the start, the system used by New Zealand banks offered somewhat more than was generally available elsewhere. The adoption of a customer number, which was common to all types of accounts, permitted the introduction of a Customer Information File which was well ahead of alternatives available at that time. The Refer List was a relatively sophisticated piece of branch management information reporting, and the Excess List and other Head Office orientated reports were not usual overseas until many years later. The branch general ledger was integrated into the overall system, a function which other banks had regarded as impossible. However, the most significant feature was probably not immediately appreciated. This was the fact that the use of a common code line and account format made it possible to relieve the bank branch of much of their labour intensive inter-branch and inter-bank exchange and settlement systems.

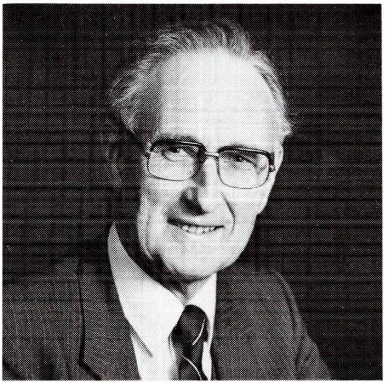
There was one attribute the New Zealand automated banking system shared with all others. It did little directly for the banks' customer, other than make it possible to sustain the existing level of service in the face of rising labour costs and volumes. Throughout the 1970s technology succeeded, even if sometimes somewhat belatedly, in providing processing facilities for increasing volumes and enhanced services, mainly by the provision of more and more powerful central processors.

During this period the common transaction format and the availability of an inter-bank settlement system, permitted the introduction of relatively sophisticated money transfer systems. Among the first was the payment of government salaries into recipients bank accounts by means of a magnetic tape received from the State Services computer system. Teachers' salaries soon followed, initially using punched cards. By the end of the decade most salaries were being paid by electronic transactions. The Trustee and Post Office Savings Banks joined in the system and the trading bank transaction format had become a de facto standard used by hundreds of programs in computers up and down the country. New Zealand led the world in this sector of banking.

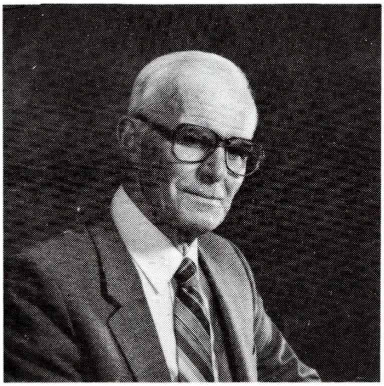
However, the offerings of technology, no matter how unique, did not always prove acceptable. In 1971 the banks introduced an advanced audio response system. Using the recorded voice of Relda Familton, the well known radio and television personality, the system responded over an ordinary telephone when bank staff keyed in enquiries on a simple keypad. Although the technique attracted a lot of attention, the need to transcribe the data on to paper before providing it to customers proved unpopular with staff. Security and identification control mechanisms had not advanced to the stage where the customer could be allowed to make the

Professor G. V. Oed, FNZCS.
First President of the New
Zealand Computer Society
1961-67.

Dr G. B. Battersby, FNZCS.
President of the New
Zealand Computer Society
1967-69.

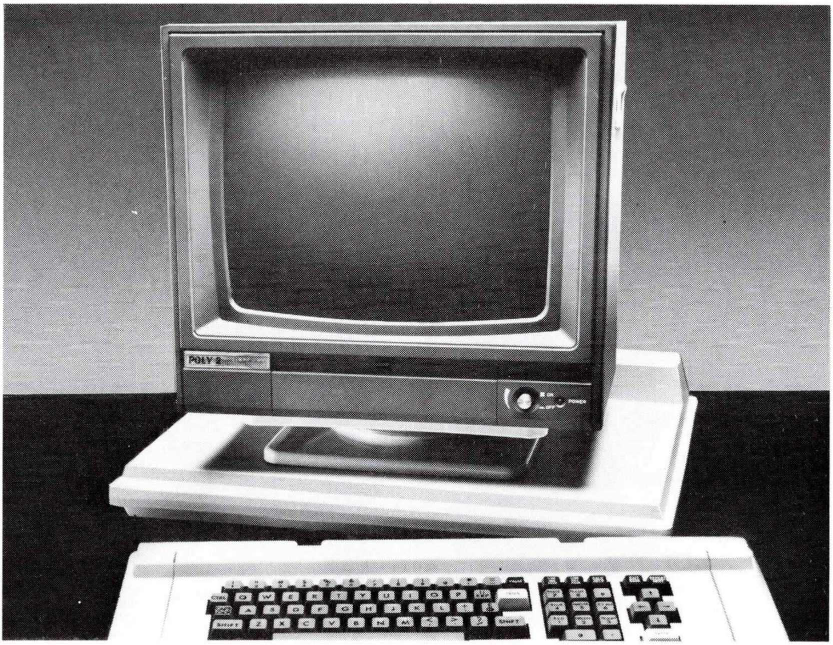


Professor T. K. Cowan,
MNZCS. President of the
New Zealand Computer
Society 1969-71.



John Lovelock, founder of Microprocessor Developments, with his company's MX6 microcomputer, designed and manufactured in New Zealand. From the 1970s onward MDL became a pacemaking New Zealand high technology company with substantial sales of its own MX Series.

The Poly Series of Learning Computers, manufactured by Progeni Systems, remains New Zealand's flagship hardware product internationally. By 1985, 12 had been installed in China.



enquiry personally, and the telephones were gradually replaced by terminals providing printed output which could be handed directly to the enquirer.

Automatic teller machines are generally thought of as products of the 1980s. But a trading bank automatic teller was installed in Vivian Street computer centre in 1974. Accessing accounts of staff members, it was capable of performing most of the functions available today. After extensive trials the system was not proceeded with, because, at that time, the benefits accruing to the banks and their customers did not equate to the cost of providing the hardware and other support facilities.

Similarly point of sale terminals were being investigated as early as 1972. On-going experiments in the United States were visited in Wilmington, Delaware; Columbus, Ohio; and Hempsted on Long Island, New York. A card swipe reader found its way to New Zealand. But the necessary card base did not exist, communication network facilities were inadequate, and the expectations of users had not been aroused. It was to be twelve years before positive activities were generated.

In 1969 all the accounts of the trading banks were being processed by six centres equipped with 360/40's having 128 K of core, a 2314 with eight removable disks, three slow tapes, card readers, printers and the ubiquitous MICR cheque readers. Auckland and Wellington got additional help from the original 360/30's suitably upgraded. At that time it was not foreseen that voucher volumes would increase at an average rate of seven percent compounding continuously for the following fifteen years. Certainly the consequences were not considered in the initial planning. The problem began to be appreciated during the early seventies, but it was being confidently predicted then that the impending advent of the Money Transfer Services heralded the beginning of the Chequeless Society. In fact, although the percentage growth in Money Transfer Service volumes has exceeded that for cheques, the systems have failed to even dent the alarming rise in paper volumes. The extent of the increase is better appreciated by looking at real numbers rather than percentages. These grew from volumes at monthly peak times of approximately 700,000 a day when all banks came on system in 1969 to well over 3,000,000 by the end of 1983.

The provision of new computer centres at Tauranga, Ellerslie and Hastings helped to allay the processing pressures developing, as did measures to improve communication capabilities but clearly new solutions were required if an upgrading of hardware, buildings and facilities was not going to be required continually in all centres. Towards the end of 1974 the decision was made to centralise update processing on large machines at Auckland and Wellington, while distributing input and output functions to what became known as the network centres. The 360/40's, under considerable strain processing masterfiles, obtained a new lease of life with reduced loadings and continued functioning right through to 1984.

The original selection of machines in Auckland and Wellington was for IBM 370/168s to be backed up by 145s in the adjacent network centres. However, a devaluation of fifteen percent and an increase in sales tax of twenty percent forced a change to second-hand 165s and plug compatible peripherals. This did nothing to ease the problems associated with implementation but the combination of hardware functioned satisfactorily for seven years following its introduction in 1976. The system software performed as planned running within both budget and time deadlines. With well over one hundred people being involved in the systems area alone it was at that time a major project even by world standards.

All network and central processing computers were front-ended by Eclipse S200 mini computers, and these were further suplemented by a micro computer to front-end the front-ends at Auckland and Wellington.

The network was designed primarily to shift bulk data between distributed network centres and the centralised databases – branch input files totalling up to 3.5 million transactions a day in and print images of up to 6 million 132 character lines from the updated accounts out. As a bonus, the network was able to handle the slowly evolving on-line terminal requirements. The Head Office needs for time sharing facilities were also met. Traffic volumes tended to space out evenly over the whole twenty-four hours, a rudimentary form of packet switching was employed to move different types of data intermixed, and extremely efficient use was made of Post Office lines.

The picture has changed rapidly over the last two years. Branch and Head Office terminal on line requirements now dictate not only the shape and capacity of the telecommunications network, but also the power requirements of the mainframe computers which support the network and its databases. Most importantly, the framework of a network now in place is capable of supporting the embryonic electronic funds transfer systems as needs develop.

As we now turn to look at the future it is well to consider the achievements and lessons from the past. By the mid 1970s most large data processing centres around the world had put their houses in order. The trauma of the late 60s and early 70s had abated, and reliable, if somewhat ponderous, systems and procedures were in place. However, all was not well. Why was this the case? Apart from the ever increasing acceleration of technological change, which created confusion through its own momentum, there were probably three major chronic causes affecting business computing.

First was the failure to understand and face up to the consequences of the generally accepted electronic data processing axiom that to maintain in production any on-going dynamic business system will usually require the continuing expenditure of between fifty and eighty percent of the original effort, time, and resource utilised to create it in the first place. The snowballing effect of this unpalatable fact put constant pressure on staff establishments and, where allowed to continue unchecked, resulted in severe strain on managerial capabilities, followed by steadily decreasing productivity in the development areas and ever increasing frustrations for the end users.

Second was the failure to understand, analyse, isolate and organise the data resources. The lack of any long term strategy, more often than not the case, was made worse by the absence of any data orientated view. It is necessary for the large volumes of data arising out of daily transactions to be segregated from processing programs, integrated with less volatile data, and utilised effectively to support decision making at top management level. The primary source of productivity gains in any business is information, in the form of support and education for a more highly skilled labour force, and in the form of research and development leading to more efficient products and delivery techniques.

Third was the failure to co-ordinate the activities of the systems developers with the aspirations and requirements of users. Too often lack of a fully detailed and agreed English language business system specification at the outset resulted in a deterioration in development productivity, and in end user disappointment. This may seem elementary, but it is still not appreciated by many that actual program coding plays a relatively small part in successful system implementation. More important is the need to establish and maintain effective and continuous communication channels between all parties at all stages and to review constantly the viability and cost of the business project as development proceeds.

The ails which beset the efforts to use the computer effectively to support business projects resulted in the EDP environment being the recipient of frequent and all encompassing cures. The banking industry did not escape attention, having several publications devoted entirely to solving its problems. One has only to thumb through the computer journals of the last ten years to recognise that few panaceas have stood the test of time. Today quick and simple user oriented tools continue to be proposed to overcome all the major problems of system development. Among those being advocated are information centres, non-procedural languages, user developed systems and packaged software.

Clearly such ideas have their place, but there is no evidence to suggest that the introduction of these methods will miraculously cure our productivity crisis. Practical experience with their use in the banking industry, dominated as it is by massive data entry, the need for extreme accuracy, the existence of large databases, and a heavy emphasis on security, has not been a story of unqualified success. It has been found that, unless carefully monitored, information centres can cause significant increases in computer costs; 'user friendly' languages are often used in areas for which they were not designed and cause major problems; user developed systems are no less prone to error and eventually may have to be abandoned because they do not fit into the overall strategy; and packaged software will often cost more to modify and install than it did to purchase in the first place. In the short run it has been found that spectacular progress can appear possible. However, without adequate attention to forward planning, requirements specifications, and the existence of an experienced development group, it is usual for initial gains to be negated by periods of regression and reduced productivity, brought on by exposure to the incongruities of the real world.

The gains achieved by the banking industry in increased productivity through enhanced technology have nearly always resulted from investments made in dollars, people and most importantly time, together with hard work and planning. In the foreseeable future, human skills, imagination and intuition will continue to be far more important than the machine. In spite of forecasts to the contrary, the much maligned experienced programmers and system designers are in shorter supply than ever, and are likely to be around, at least in the front line of business computing, well into the twenty-first century.

Nevertheless the winds of change are blowing through the computer ranks and their chill is being felt particularly in the banking industry. New technologies are being developed, and systems are being perfected, which make it economically possible to extend data collection out beyond the confines of bank branches, and eventually even to the location of the customer. It has become possible for newcomers to enter the market place in ways in which they have not been able to do before. The chains of retail outlets, which have been the traditional banks' great strength, will no longer provide a monopoly of banking services as they have done in the past. Electronic banking services do not need a traditional outlet. All that is required is an integrated terminal network, plus entry to a banking exchange and settlement system. The way is open for financial institutions to use technology to create radical new business opportunities.

Two major factors are influencing trends in technology and are affecting the financial services sector. Firstly the convergence of computing and communications has seen the development of local, national and international networks which are tied together and justified on economic and technical grounds. Secondly the dramatic emergence of relatively cheap but powerful silicon chips has resulted in cheaper computer hardware, and increased the potential for distributing computers throughout a bank, with the eventual aim of having a personal computer on every worker's desk.

Strong pressure is being exerted by battalions of micro computer salesmen to jettison the large mainframe computers and return control of the banking operation to the managers at the workface. The arguments are very compelling and for some functions, a more efficient and cheaper solution can undoubtedly be provided by these methods. For a large centralised operation like a bank, however, distribution of computer power immediately creates problems of control and security and would only be successful with a very different management structure from that which exists today.

Decentralisation also creates software and database problems. Different micros use a lot of the same computer programs. It is expensive to have each local branch individually supporting all its software and data needs, and making room for the programs in the memory of each machine increases the amount and cost of memory required. Also many branches would use the same data. If this data is stored on separate databases in each branch, then every time a change is made to it in one area, the same change needs to be made in every other. Keeping tabs on all the changes is likely to be difficult and costly.

It makes sense to have one big central database and software store which can send data to each local region when needed. The big snag has been that the links over telephone lines used by existing national networks in New Zealand have been slow and unreliable. They are adequate for moving transactions but are not yet viable for even modestly sized databases. Developments in fast local networks have outstripped advances in the national links, but they themselves are little more than prototypes. The Post Office in New Zealand plans to have Auckland and Wellington connected by fast digital networks but it is likely to be 1990 before all points at which banks have outlets are connected. There is also a lot of work to be done on the problem of linking fast local, national and international networks together.

The technological trends which appear to be emerging and which would fit most tidily and economically into the New Zealand banking scene would favour a layered structure:

1) Large central computers containing the centralised databases, the financial interchange and settlement systems and the national store of application programs, together with the global communication and control systems to distribute and manage the financial activities of bank branches, and their customers.

2) Regional computers, probably sited at existing network centres, to hold small portions of the central databases and relieve central computers of as much communication load as possible. At the very least, these would handle local automatic teller machines, point of sale, home banking, and in-branch credit authorisation type enquiries, and concentrate transaction data and message switching traffic for onward transmission to central sites at times offering optimum efficiency in the use of the global system. Some branch management and customer information would be available. Regional centres would also supply physical support to ensure the local network and branch equipment is kept running at a high level of uptime.

3) Local personal computers located in bank branches and customers' premises capable of performing stand-alone operations but also connected through the regional computers to the central databases and software stores. Depending on the size of the branch these machines would also function as word processors and videotex terminals. Detailed personal computer information would be recorded and maintained on removable off-line storage capable of being up-line loaded to central sites as required and thus reduce the pressure on expensive central storage facilities.

The opportunities offered as a result of enhanced technology to effect the introduction of on-line real time banking have not been overlooked by the Post Office and Trustee Savings Banks. A terminal network including some 450 teller terminals has been in place at the Post Office Savings Bank since 1976 with some three million accounts on-line. The network is supported by three regional processors and one fully backed-up mainframe site. The processing philosophy involves the use of 'memo post' files on-line during the day with overnight batch processing to validate on line transactions, add transactions such as direct credits and cheques cleared from external sources, generate and process automatic payments and extract outward transfers for exchange with other financial institutions. A major systems upgrade is now underway.

The Trustee Savings Banks see New Zealand as having an almost unique opportunity to lead the world in technology based banking services. Giving credit to the trading banks for establishing an integrated processing system which eliminated float and provided same day debiting and crediting of transactions originating anywhere in New Zealand, they nevertheless contend that the heavy commitment to batch cheque processing makes it more difficult for the trading banks to move to a real time environment. By contrast, they claim the majority of trustee bank transactions are across the counter, facilitating the rapid development of real time processing and electronic banking services. Currently there are four centres providing data processing services for all the New Zealand trustee banks. All four centres are linked by a new network that allows transactions to flow between branches using a standard trustee bank inter-bank format. A transaction made at any trustee savings bank anywhere in the country is updated at its home branch in real time. Electronic banking transactions such as direct credits and those via automatic teller machines are handled in the same way, in real time, with on-line updating of the bank's masterfiles.

The trading banks would no doubt contest some of these assertions, and it is at least problematical whether they will be required to carry the burden of cheque processing for many more years. In any case their branch terminal population of over 4000 requires a network of different proportions to any other in New Zealand. In the early 1970s the banking industry experts, confidently predicting the arrival of the Chequeless Society, were wrong. Today these self same pundits are equally sure the cheque will be with us well into the 1990s if not for ever. It is worthwhile giving careful consideration to the possibility that this latter assumption is equally fallacious. A number of factors now exist which militate against the survival of the cheque other than as a special purpose instrument.

Automated money transfer systems such as direct credits and automatic payments now account for twenty-two percent of all banking transactions in New Zealand. The technology exists for considerable expansion, both in the retail area for bill payments and budgeting systems, and in corporate banking with company trade payments spawning off from the embryonic cash management system.

The surge into automatic teller machines in spite of doubtful cash/benefit analyses has proved surprisingly popular with the consumer. It has also seen the development of joint ventures amongst financial institutions along the lines of similar projects overseas.

Activity is also growing in establishing home banking projects using videotex and in point of sale retail systems. Once again non-bank financial institutions together with large retailers are at the leading edge of these developments and in competition with the traditional banks.

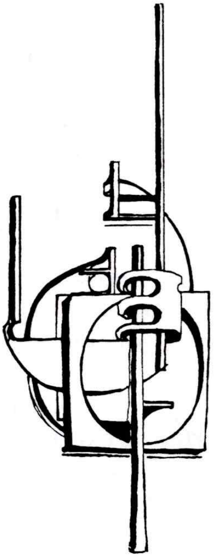
Customers using financial services are changing their behaviour more rapidly than ever before. They are splitting their financial relationships among different institutions and, at the same time, aided by the rapidly falling cost of technology, are demanding better control of their finances. This is coupled with an increasing number of two career families, a greater emphasis on personal leisure time, rising fuel costs and lack of parking spaces, and an increased awareness of electronic products. The net result has been that the customer has become more receptive to home banking, home shopping and related services.

The most important prerequisite to enable these customer expectations to be met is an adequate communications network coupled to comprehensive computer facilities. Overseas the marriage of the heavily regulated communications monopolies to the free-wheeling computer industry has not always proved a happy one. In a small country like New Zealand it is important to avoid capital and human resource wasting strife, but this will require balanced diplomacy from both sides of the equation.

The financial sector in the future will require in one network an integrated array of different services. The network must provide universal and complete facilities for capturing, storing, processing and transporting most of the financial transactions and information which institutions want to process or communicate. This is a massive undertaking and the hardware, software, and human skill resources required are being grossly underestimated by most, if not all, of the potential participants.

The nature of the services required will vary from a simple enquiry to the bulk transmission of data, electronic mail and possibly even the provision of high resolution video. Automatic tellers, point of sale, front office terminals, videotex and teletext will all require to be supported. To achieve this the functional elements of the network must include transport paths, intelligence, information and storage together with a level of security far in excess of what is acceptable today. The basis of such a network is already in place in the trading bank system and should permit an orderly and economic evolution from a MICR cheque dominated financial services operation, to a philosophy based on handling electronic transactions.

Over the next decade, however, the need for enhanced communications facilities providing greater capacity and higher speeds, will begin to emerge. This need can only be met by a planned mix of new technologies utilising fibre optics, domestic satellites, coaxial cable, and improved use of existing copper wire; all of which need to be synchronized with the new high speed digital networks which will be introduced by the Post Office as the benefits of IDN (Integrated Digital Network) and ISDN (Integrated Services Digital Network) become available. Such developments will require a much greater measure of co-operation between all participants if achievement of the full potential, latent in the introduction of electronic transaction and electronic information systems, within the financial services industry, is to become economically feasible in a nation with the population size and limited resources of New Zealand.



CHAPTER FIVE

COMPUTERS IN BUSINESS AND INDUSTRY

S.J. Bell

Stephen Bell's background covers both working in the computer industry, chiefly as a programmer, and as a commentator on the computer scene. For four years, from 1974 to 1977, he was a journalist on the staff of the British publication 'Computer Weekly'. He came to New Zealand, having married a New Zealander, as editor of 'New Zealand Data Processing' and, when this paper was absorbed into the 'National Business Review', took over responsibility for computer and technology coverage.

The early days of computing in New Zealand were, not surprisingly, dominated by the government but not long after the public sector made their pioneering moves into electronic data processing, private firms began to take advantage of the innovation presented by computer technology.

In the vanguard, naturally, were the subsidiaries of worldwide and overseas conglomerates which could take advantage of existing developments by their parent companies. But local pioneers were not long in coming; a Lower Hutt paint manufacturer, BALM paints, subsequently absorbed by Dulux, spawned not only one of the earliest industrial computer systems, but also one of New Zealand's software pioneers. Perce Harpham emerged from his Dulux experience to found Systems & Programs Ltd, now Progeni, New Zealand's biggest software house.

From these early days of private sector computing it was a matter of virtually uninterrupted exponential growth, despite a severe scarcity of computer expertise. A census taken in the mid 1970s revealed at least 150 computers around the country; an industry in its own right already employing more than a thousand people.

The early machines were proverbial monsters with little internal storage and even the program instructions themselves read and executed from ungainly storage 'drums'. Internal circuitry was built from transistors and other discrete components or even failure-prone thermionic valves. The first major innovations driving the New Zealand private sector business market came around 1963, with the arrival of integrated circuitry, random-access memory and the first of the real 'families' of computers, the IBM 360 series. This gave some promise of growth in computing power to match the growth of the businesses themselves. The 360 brought the second wave of New Zealand business computing with major local companies like Dalgety and Cable Price Downer taking on the new machines.

Early business applications were, for the most part, fairly standard tasks – essentially substitutions for clerical work. The key justifications were always higher productivity, reduced cost and fewer staff. Manual procedures were duplicated fairly closely and often with little imagination. There was none of the 'improved management information' sought these days as first priority from commercial computer installations. Some commentators would contend that this 'bottom-line' attitude has never quite left New Zealand management and its use of computing power. As one analyst of long standing summed it up, 'Creditors, debtors, general ledger and those classic accounting jobs made up most of the early workload; with insurance companies it was premiums – all the same job really. Trying to get people to pay the bills.'

The accounting emphasis came partly from need and partly because 'there were already people around who knew how to do it'. Such applications could essentially be run in the same mode as the earlier 'unit record' equipment – the tabulators – put the master record, balance forward and payment details in one end and a new balance forward came out the other.

And, as to whether the 'bottom-line' benefits actually materialised, it is a doubtful and in retrospect a muddy picture. Few definite statistics are available to us to indicate whether those early computers ever made a sufficient return on investment to justify their purchase. It is safe to say a good few did not and became cursed – unfairly perhaps – as millstones around the neck of the organisation. More than one company found itself complaining that it had to raise the prices of its goods to pay for the escalating costs of the computer that had been bought to reduce costs.

The computers of the 1960s were dedicated machines, most of them running a single application at a time, scheduled externally by paper instructions. Even when the sophistication of operating systems and multiple concurrent streams of work arrived, the aim was still to speed up the manual processes. Vast paper files became vast disc files and vast computer-generated reports, and disciplines of 'back-up' and security were primitive at best. Too often, the valuable information 'resource' of the organisation could be lost or damaged beyond repair. Then it was a matter of going back to the paper files and painstakingly regenerating everything.

There were inevitably stories of the failure of entire computer projects and of companies who were badly 'burned' by the whole experience. It is hardly surprising, in such a small market that many of the disappointed users turned back to computer bureaux run by supposed experts, and that the bureaux thrived. A high proportion of the early 1970s 'large' computer installations belonged to businesses subsisting entirely on running data processing for other companies.

At the same time, there seems to have been a hesitancy at the very beginning to admit failure openly. 'Not that many actually backed out', one consultant contended. 'A lot of inefficient systems were kept going.'

Computing in the 60s and early 70s was a job requiring dedication and a reasonable knowledge of the intricacies of the particular machine. The turn of that decade had seen the maturing of 'standard' programming languages; but a standard was never exact, and if, by a detailed knowledge of the machine or bending the standard, you could make the program run faster, that was all to the good.

In the earliest days, there was a moderate input of recruit programmers from accounting and other conventional office disciplined people who had 'been round the traps', as one early user put it, and knew the business of the organisation. It was, however, not long before these yielded to the beginnings of the 'technocrats' who were becoming visible even in the late 60s. They are usually thought of as some kind of boffin. 'Most of the new people had an electrical bent or they were the sort of people who took motorbikes to bits over the weekend.' There also appeared to be a predeliction for mathematics graduates. This view is perhaps an over simplification and many early computer recruits came from totally unexpected backgrounds; some of them continue as influential figures in New Zealand computing to this day.

Since government agencies were the first in the field it is not surprising that much of the original selection and training of computing staff had been done by the government and there was a flow of staff from the public to the private sector. It has been claimed by some that central government effectively became, and remained for more than a decade, the trainer to most of the industry in New Zealand; 'The wastage of staff from government, particularly Treasury was terrible,' said one government pioneer. It was only after persuasion from the government that the technical colleges started practical courses on computing to supply some of the missing expertise.

A good deal of reliance was placed on 'aptitude tests'. Although they are not as extensively used today there is, in retrospect, little doubt that they fulfilled a need at that time. They even had their strong advocates. 'When we did trust to our instincts and take on someone who couldn't do the test, it was usually the test that proved right in the end,' said one early manager.

The real problem came in the interface with the user. 'Because the programmer knew about computing, he – or she, there were a few women in those days – was expected to know all about accountancy and the way the business was run as well.' The natural result of such assumptions was poor specification and poor design of systems. 'The end users were unable to describe what they wanted, and expected the computer people to fill in the gaps.' In the mid 70s, industry observers could still complain, with some justification, that 'most DP personnel have tended to neglect general management principles ... and, the other side of the coin, general managers normally are not as familiar with systems design principles and computing techniques as is desirable, given the relative level of expenditure on computing'.

One other major source of computing expertise in the early days was the computer companies themselves. 'A lot of the early DP managers at IBM 360 installations were former IBM sales executives,' recalled one of those early users. 'If you bought a 360, you bought a man with it.' IBM was then and has always remained, the dominant force in the market, with ICT, later ICL, holding second place well into the 70s. Burroughs and NCR also expanded quickly, capitalising on their existing presence in the accounting machine market.

When applications became less basic and were required to meet the wider individual needs of the organisation, program development emerged as a painstaking 'hand-crafted' business, often it appeared an end in itself. Design of complex individual systems was lovingly recounted in the computer press of the day and at conferences. The idea of designing and developing one's own database management system, as Winstones did in the early 70s, would be unthinkable today but not so then. The users of those days seemed to look to the computer supplier chiefly for hardware power and the suppliers were happy to go along with this viewpoint considering themselves to be in business to sell hardware. 'Hopefully, the supplier will come to discuss not only his equipment but also his programs,' said one optimist, somewhat ahead of his time.

Software packages took a long time to emerge into full business acceptance; the usual criticism of the 70s packages was that they were too rigid to meet the different needs of individual organisations. The commercial system was 'not a simple-minded aggregation of boxes acquired from the public market,' said a contemporary IBM commentator. 'It must match the using company as a suit must match the wearer.' A tall order for those days (1974). Systems development expertise was still a rare commodity, and combined computing and business knowledge even rarer.

What was happening was that a new concept was beginning to pass from theory into practice; the idea of the computer or complex of computers as a management information system. The computer was to be seen no longer purely as a business processing workhorse for individual applications, but as 'co-ordinating prompt control of information as an aid to better decision-making'. 'Applications' were not simply band-aids or poultices to be slapped on that part of the organisation that was hurting. Thought was being given to the long-term requirement for information, when it was needed, where it was needed and in the format in which management needed it.

Unfortunately, it was and still is a difficult task to be all things to all people – to anticipate all possible demands for information. The techniques for canvassing requirements and translating them into an appropriate universal 'model' of the necessary data were lacking and many management information systems were fated to fall far short of their expectations. Nevertheless a start had been made and there were two technical developments that were helping the process. Surprisingly they at first seemed to be offering two conflicting solutions.

The first of these was the move of the mini computer into the commercial areas. The original 'minis' were thought of primarily as machines for scientific and industrial applications but once accepted in its commercial role, the minicomputer showed itself as particularly appropriate to the smaller New Zealand scale of business. An early prediction that the growth rate in minicomputer use would reach twenty to twenty-five percent a year, compared to fifteen percent for large computers, was amply justified. In a way, the profile of the minicomputer foreshadowed the later growth of the micro.

But it also had another effect. It brought the dream, if not at once the reality, of 'distributed processing' – taking specific tasks away from the central mainframe and into the individual department or district office. In this way management much further down the chain, could control the flow of information necessary to carry out their tasks, the essential ingredient of a management information system.

The second was the advent of on-line facilities. In its simplest form this merely replaced batch processing by giving operators direct access to the files. They could then update the records or abstract information 'on-line'. In its management information mode the communication lines were extended to reach into remote locations to where they provided the same, or some would say superior resources, to those of the on site mini. On-line computing came first in the guise of the 'star' shaped network, centred on one large processor. Indeed, it could be said that the terminals made the computer system more centralised than it had been. The need for immediate information and the likelihood that one terminal operator would be looking at many sets of data, bred the idea of the centralised 'database' in place of separate 'files' for different jobs.

Individual proponents of centralised and distributed processing are still with us today, though it would probably be fair to say that the distinction is becoming somewhat blurred.

The 1980s brought many developments but they will be remembered more than anything as the years of the microcomputer – the years when the small desktop machine grew from its hobby and educational role to take its place in serious business information handling. For the computer market worldwide, this meant another massive shake-up but for New Zealand it had its own significance. The computer now became relevant to a new and smaller scale of business, one much represented locally. As with most hardware development, its growth here was retarded by a lack of suitable application software for local use but more important was the lack of a suitable marketing base. The early micros did not come from the big companies with an established presence. For the most part they were sold by relatively small traders with agency arrangements. For small indirect vendors to become acquainted with their new product, so as to be in a position to advise prospective customers whether it would meet their needs and to provide after sale support, proved to be a difficult and costly task. Not all succeeded.

A further handicap was the forty percent sales tax imposed on 'office machinery' by the Labour Government in 1975, largely for fear of job erosion. In retrospect, this was an inexplicable decision, widely regarded as having prevented small businesses in New Zealand from taking advantage of benefits of computing power for several vital years.

There are arguments that the high price of small computer equipment had a beneficial effect – holding back decisions until there had been more opportunity for careful thought; and leading, perhaps, to the development of software which used the machine's capabilities more efficiently than did software developed overseas. Because of the relative size of businesses and the cost distortion effect of the tax, it has been said that where a United States or European company used a mini or a mainframe computer the New Zealand company had to do the same job with a micro. We certainly seem to have been saved from the worst excesses of 'personal computer fever'; a rash of unco-ordinated applications, using contradictory data, growing on a multitude of separate machines bought by the more 'enterprising' executives within the company.

These were the positive effects, but the negative impact of the now abolished tax will be felt for some years to come, in the shape of a long-term lag in development; longer consideration has not always meant better solutions and there are still false paths to go down, several years after overseas users have had the chance to learn from their experience.

The big impetus for business micro development came when the tried and trusted names began moving into this part of the world. IBM's Personal Computer met an enormous pent-up demand when it came to these shores in early 1983, eighteen months after its release in the United States. Against the expectations of some sceptics, it rapidly established a leading position in the market here and world-wide, and begot its enthusiastic imitators. The IBM led to a flood of software from local and overseas developers to work with the new machine, and, in turn the flood of IBM PC software begot IBM PC-like machines designed to accommodate that software. The microcomputer customer base, IBM and non-IBM, grew steadily. What was more astonishing was the growth in local agencies for micros. Almost every significant machine in the world was represented on the small New Zealand market within a few years. There were repeated predictions of 'shakeouts' in the industry. With only three million of us, the sceptics said, sooner or later, everyone would have a micro, and with so many vendors operating in the market, some would have to founder. But the predictions proved unduly pessimistic. More agencies rapidly came in to replace those few which did expire, and to pick up on an ever-expanding range of products. The biggest casualty came later with the demise of not one, but two successive local enterprises named Access Data. First Access Data Ltd, then its successor Access Data Corporation, distributors of the Altos multi-user micro, went into receivership in 1983. There were various theories to account for the collapse. Access Data had been one of the more visible presences on the local micro market, and its failure sent shock waves through a vulnerable user community which had always had to ask itself, 'will my local microcomputer distributor still be here to support me next year?'

While the microcomputer grabbed the limelight, significant changes were also taking place in the use and acceptance of the larger computers. The IBM imitators began eroding some of the dominant presence of IBM and the other big United States names. National Semiconductor, Fujitsu and Amdahl all found footholds in this country. Eating away at the bottom of the mainframe market was the ever-expanding mini, with new entrants like Prime Computing showing sudden major success in the local and Australian market. With minis pushing into the mainframe territory and the powerful micros taking over the 'mini' slots in the market, traditional boundaries between the three categories became blurred.

As the local computer users matured, they began in any case to think in terms of a connected 'system', a co-ordinated 'solution' to business information management, using whatever individual pieces of hardware and software were most appropriate. Increasingly, users were encouraged to make an exhaustive analysis of the information required by all parts of the company before buying. Standard packages and equivalent hardware and software offerings from many sources, and the broad range on offer from a single supplier made this approach easier. But the old 'hardware first' technical approach has proved a habit difficult to kick.

The spreading of the 'information system' tentacles outside the computer room, both by means of on-line systems and the take-on of micros by non-DP-trained executives, together with the 'systems' view of a company's total information requirements, led to consideration of new ways of handling the flow of information. There were those who questioned how effectively the policies of management made themselves felt through the intermediate filter of the data processing department's attitude to information processing and the role of the DP manager himself came under scrutiny. But it was soon clear that there were some hard decisions to be made on the integrity of the company-wide information base once everyone was allowed to dip into it and control was still necessary. Despite some adventurous proclaiming of the 'information democracy' the DP manager stayed on to fill this need.

There were also other problems arising at this time. New users had meant a new software development load when software development was already seriously behind schedule in most organisations. Local software ingenuity came up with part of the solution with practical applications of two separate approaches that were being considered, both here and overseas. One was to improve the productivity of programmers by providing them with better programming facilities. In this Progeni played a leading part with its PROGENI TOOLS. The other was LINC, one of the early 'fourth generation' systems development languages. Such languages aimed at allowing the problem to be specified in pure information and business terms and converted automatically to the technical vocabulary of the computer system. Many such '4GLs' were springing up all over the world but LINC, supported by Burroughs Ltd, on whose machines it was designed to run, received world wide acceptance.

While there were suggestions that fourth-generation languages would do away with the need for specially trained programmers, this proved not to be the case, although many successful applications have been prepared with little or no assistance from data processing staff. The chief merit of fourth-generation languages is not that management can do all its own systems development and programming, but that the vocabulary is at least understandable to users who can draw up their specifications in a way that considerably reduced the load on the designer and reduced the risk of misunderstanding. They are also relatively easy to alter. A technical systems developer can show the potential user a quickly-developed system and the latter will have sufficient understanding of it to point out any deficiencies and suggest improvements, a technique known as prototyping.

A more general solution to the information gap between user and systems developer was sought in the provision of simpler methods of information retrieval, manipulation and reporting. So arose the 'information centre' concept. Promoted initially by IBM, it was clearly a non-machine specific answer. It advocated the provision of small software packages for the standard tasks of information retrieval, analysis and presentation, teaching the non-technically-minded users how to use these facilities and then leaving them substantially to their own devices, to handle their personal needs, with the occasional helping hand from professional DP staff. Several large firms adopted the idea, with mixed success. Sooner or later, in all but the simpler cases, it was found that the DP staff were needed to take an active role, rather than merely offering discreet help. Nevertheless the concept has considerable merit, requiring as it does, the active involvement of users in the development process.

An unusual feature of New Zealand's use of computing is the relative lack of direct application in the primary and manufacturing industries. But perhaps this is not surprising. Kenneth Owen in a paper on *Computers in Industry* prepared for the International Federation for Information Processing had this to say:

> Information processing for those whose job is to process information can be a neat and tidy affair; but for those whose job is to make things, or to run industrial processes, information processing is a more difficult and untidy matter.
>
> Successful industrial computing systems can transform the business performance of manufacturing and process companies. These benefits have been demonstrated in large companies and are becoming progressively more relevant to smaller companies also as the cost of computing continues to fall. Computer aided design and computer aided manufacture have become familiar and fashionable as CAD and CAM, but there is more to industrial computing than CAD and CAM – and indeed, there is more to CAD and CAM than is represented by today's state of the art in mechanical engineering.

There has been the odd outstanding effort in flexible automation and control of the manufacturing process – Fisher & Paykel must rate a mention here – but statistics acumulated by the DSIR show that even the use of computer-driven numerical control machine tools has been slow to take off. Robots are virtually absent. Effective use of the information-control aspect of manufacturing – material requirements, planning, work scheduling and monitoring – is still not widespread.

'Office Automation' has been the other watchword of the early 80s. From the initial perspective of automating the work of the typist and secretary with a word processor, the rise of networking capability and the desktop computer has brought new meaning to the term. Office automation now includes, theoretically at least, the use by middle and upper management, to draw information from the company database and use it to formulate reports and generally assist in the decision making process. But successful use of the new potential has been patchy. There are still very few companies where electronic mail whizzes back and forth over the local office network, and the use of the desktop micro seems again to have stagnated at the word processing level, with the possible exception of the 'spreadsheet' financial modelling techniques now becoming popular with financial managers.

A more recent arrival among the ways of presenting electronic information is videotex, which has grown to prominence on the local market. Originally devised in the United Kingdom as a way of providing information in the home using the domestic television set as a terminal, it has matured into a simple communication and presentation technique for general business use and can send messages back in a similar fashion. The user calls up information by page number or 'menu' selection, often on a purpose-built terminal and he can send messages in a similar fashion. It took interminable bureaucratic discussion to bring the concept to fruition in New Zealand. Who would control the information – the Post Office or private industry? Which of several competing communication procedures would be used, and what effect would it have on the load on Post Office communications lines? But over the past two years, videotex has begun to be taken up with enthusiasm by operators of channels for all-purpose information, and particularly by suppliers of financial information – brokers, finance houses, the Bank of New Zealand and Databank.

The supply of business information through more conventional terminal networks also took off in the 1980s, on the basis of information services originally developed for in-house use by large companies, and through the Post Office's Oasis link into the United States databases of commercial and technical information. Prominent observers of the New Zealand business scene, however, still lament the lack of use of such information channels which should, they say, be more widely called upon for product and market information vital to our international trading efforts.

Looking back it would be safe to say that the computer industry in New Zealand has come through a long period of evolution as a fragmented entity; many small ventures, a few large, and a sometimes uncomfortable mix of locally-owned industry and the subsidiaries and hangers-on of multinationals. Some notables have emerged; Progeni, Microprocessor Developments Ltd and David Reid with their efforts to build local computers, and many more on the software and consultancy side including early-comers such as Progeni (who started life as SPL), Datacom (formerly CBL) and Computer Consultants Ltd. In the wake of LINC's success in particular, the potential of locally produced software as an export commodity has been widely recognised.

The computer industry had hoped for recognition and encouragement from the Industries Development Commission's review of local electronics. But the final version of the Electronics Industry Plan rather watered down the original intention to move from consumer to professional electronics and the computing services industry expressed particular disappointment at the lack of recognition of its efforts or consideration of its potential. In spite of the lack of official encouragement there as been steady progress. NZI's Paxus Information Services Division has grown from the bureau beginnings of IDAPS (NZ) to a multi-faceted Australia/New Zealand operation, and has absorbed many smaller but highly regarded companies along the way, including the Australian Hartley computer hardware manufacturing operation. The Andas Group has risen from Armstrong & Springhall's office equipment operation to embark on a similar path, both under its own name and through the associated Powercorp complex of companies.

The rapid development of the use of computing in the late 70s and early 80s led to increased concern over attendant social problems, from the privacy of personal data, to the effect of electronic information and electronic 'labour' on the structure and employment prospects of industry. The question of privacy was highlighted by the development and use of the Wanganui Law-enforcement System, and the collapse of the Creditmen Duns credit agency with the subsequent offering of credit information tapes for sale. But more heat has been generated than real light, and this country still lacks any broad-ranging legal privacy protection. Concern with the employment consequences of automation waxes and wanes. After some clear concern in the early years of this decade, the benefits of computer aid, particularly in clerical and office work, seem to have calmed some of the fears. But the misgivings are still undoubtedly there, and a further downturn in employment could bring them fiercely to the fore again.

These questions are examined more fully in the chapter on Social Implications. They are very important but the problems will be overcome. Computing in New Zealand, it can be safely said, enters its second quarter-century in every sense as an established part of the business world.

CHAPTER SIX

EXPERT SYSTEMS AND THEIR IMPACT ON THE PROFESSIONS

W.R. Williams

Bill Williams' introduction to electronic data processing came in 1962 when on secondment to the Royal Navy. He continued his interest and was eventually appointed to the Defence Department's then newly formed Computer Division. Retiring from the Navy in 1970 he joined the pioneer software house SPL (now Progeni). He also joined the Computer Society and has served both as Chairman, Wellington Branch and as a National Councillor. While still with Progeni he took over the part-time post of Secretary. When it became apparent that more support from the National Office was needed to cope with the Society's expanding activities he 'retired' for a second time so as to be able to devote more time to Society affairs. Currently he is serving as Executive Director.

It is probably true to say that it is members of the professions, lawyers, doctors, architects and educators who, here in New Zealand, have been the slowest to appreciate the effects that the new technology will have on their work. Trade unions were also rather slow at getting off the mark but, once alerted, have taken a very active interest in developments. The effects on skilled manual workers are perhaps more noticeable, after all it could not have been too difficult to see what word processors would do in the office or how robots would change the production line. Even so, one would have expected the professions to be equally perceptive but, while there will hardly be a union official who is not anxiously looking at the impact computers will have on his members, the same cannot be said for the professional bodies.

One major profession has been left out of the list given above, namely that of engineering. This is because, here at least, there is a strong core of practitioners using advanced computer technology in their work. Mention has already been made of the Ministry of Works in this respect. There are also other honourable exceptions and New Zealand is not without its pioneers in the field of expert systems; individuals working in such areas as computer aided learning and specialised areas in medicine and law. But professional bodies as a whole lag behind. There are still graduates coming from New Zealand law faculties and the medical schools knowing less about computers than the average sixth former. Yet all will be using computers within the next decade and hopefully there will be some, as they become more senior in their selected fields, who will be active in the design of expert systems themselves. For the time cannot be far away when expert systems will be universally recognised as the best way to pass on the hard won knowledge and experience of a lifetime's work.

If we are going to talk about expert systems it would be well to define exactly what we mean. They are a part of the wider subject of 'knowledge engineering' which again is a sub-set of artificial intelligence. While the concept of an expert system has been around for some time the term itself is relatively new. For our purposes we will define it as:

> *A computer application which uses the previously stored knowledge of those highly qualified in a particular field, to solve problems that otherwise would require the human intelligence of similarly qualified persons.*

An early example may best illustrate what is meant. Back in the beginning of the 1970s an experiment was conducted in Glasgow to try out the idea of using a computer to take a doctor's initial case notes. It was surprisingly successful. Most had expected that patients, who had predominately a working class background, would resent answering questions from what was in effect no more than a computer controlled typewriter (no readily available VDU screens then). But this was not the case. The patients said that they were less intimidated by the machine than by the presence of a doctor. They were more inclined to say that they didn't understand the question, to ask for clarification and to take their time in answering. Quite unexpectedly it appeared that they were also more truthful, almost all admitting to imbibing more alcohol than when questioned by the doctor himself!

Responses for the most part were confined to a simple YES/NO/DON'T KNOW. The doctors who participated had had to sit down and formulate the questions so that they could be answered in this way and to construct a sequence of questions that would take note of previous responses so that, for instance, a patient who had been identified as a male would not later be asked questions relating to childbirth. The programs used were primitive, they probably would not be regarded as an expert system today. Indeed the procedures covered only one facet of expert systems as we know them. However, whether or not this was an expert system it did have the one essential ingredient, that of co-operation between experts and computer system designers. Since then much more sophisticated systems have been developed. Those who remember the BBC programme *Now the Chips are Down* will recall seeing a team of doctors headed by a well-known specialist working on such a system. The aim was to make available to doctors in all parts of the world the same assistance they would receive if they were able to consult the team personally.

In the latter example we have the essence of expert systems. They are at their best when they have been prepared by specialists in clearly defined areas for use by professional people in their day-to-day work. The specialist almost certainly will need the help of those who have studied and thoroughly understood the advanced computer technology involved but in the end a particular system will stand or fall on the ability of the expert to communicate his knowledge and skill in this way. He, in turn, will do this best if he has a good understanding of what is involved on the technical side.

There are in New Zealand a few who are studying expert system design. One of these, Graham Wrightson of Victoria University, has written a paper to be published in the NZCS Journal on this subject. The present chapter draws heavily on material in that paper. In his introduction Graham Wrightson says:

> Electrotechnology has wrought great changes in the way that professions fulfil their various roles. Figure 6.1 offers an estimate of how the four principal components of the professional's work have shifted in the past and will shift in the future. Physical activity has declined and probably will continue to decline as a result of increasingly powerful, accurate and dexterous electromechanical devices. Over the last century, entrée into professional work has required increasingly long training and apprenticeship, a process catylyzed by the growth of specialization. But knowledge systems should soon begin to assume much of the burden of memorization and information retrieval, leading to a

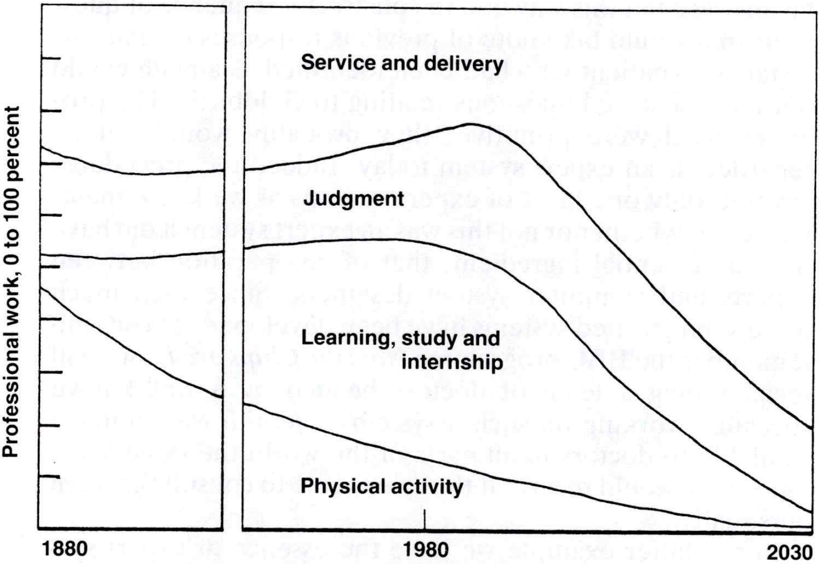


Fig. 6.1 CHANGING CONSTITUTION OF PROFESSIONAL WORK

steady decline in the duration of professional training. Service and delivery – the actual output of professionals – have decreased recently in proportion to their other activities. But this decrease, caused by the extra effort required of modern specialists to keep pace with the exponential growth of information, will shortly be reversed as artificial means are developed for assimilating and applying knowledge.

The only major component of a professional's work that I believe has not changed and will not change substantially is judgement, which might be seen as the constant by which the professions are defined. When judgment vanishes, the profession vanishes. As Figure 6.2 illustrates, the capabilities which comprise professional judgment change over time. Largely in response to the enormous growth of information generated by electrotechnology, professionals today need a balanced mix of capabilities in order to perform effectively. In the future I expect knowledge systems to reduce the time a professional will need to spend in memorization, gathering, analysis, and reasoning to reach useful judgments. However, intuition and perception, two distinctively human skills, will become more and more important, especially in

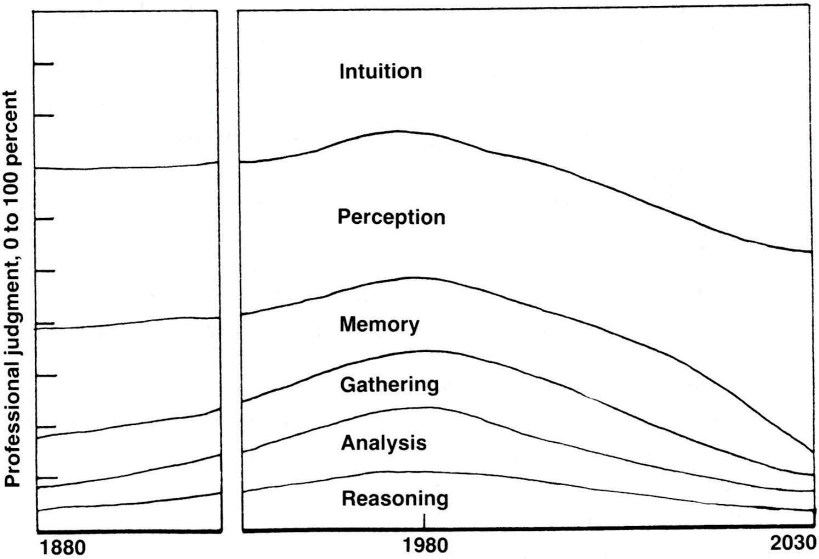


Fig. 6.2 CHANGING CONSTITUTION OF PROFESSIONAL JUDGMENT

> proportion to other skills. Knowledge-based systems, and expert systems in particular, have recently gained significant economic and scientific importance. There are several reasons for this. Firstly, there has been an ever increasing demand for expert consultancy; secondly, there have been tremendous cost reductions following the computerisation of expertise otherwise only available from highly trained specialists, and thirdly, expert systems have accomplished some amazing results.

He goes on to provide examples of expert systems that have proved their worth. These are listed in Table 1. Included in this list are two New Zealand systems, DAMP and COMIX, which Graham Wrightson and his students at Victoria University have helped to design.

Expert systems would not be possible without the computer and, indeed without the very powerful computers of today. Not only must they be capable of holding and searching through large volumes of data and of exploring the well nigh endless permutations and combinations that are inherent in such systems, but they must also be capable of carrying out a meaningful dialogue with the user. Perhaps we could look briefly at some of these factors.

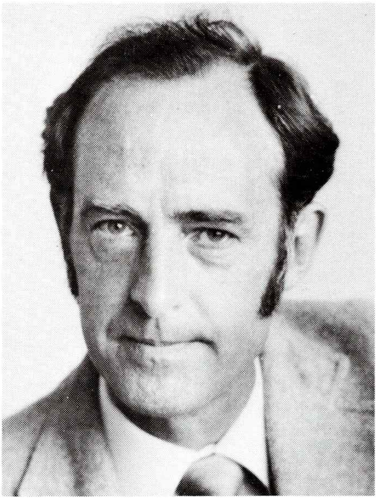
Techniques for holding data and for searching through data files for particular records have been under study for many years. Typically, expert systems have to handle large quantities of poorly structured data and they present some of the more difficult problems designers encounter in this area. None of the methods available could be considered ideal, each has its strengths and weaknesses, and it is a matter of choosing the best to handle each particular application. A correct choice is vital. A mistake at this stage could result in a clumsy or even inoperable system. A particularly disquietening feature here is the fact that the error may only become apparent when attempting to run the system under full operating conditions; trials with smaller test files may well have failed to reveal the inherent weakness. The system will almost certainly have cost several man years of effort by this time and all this will have been wasted.

The next requirement is, however, the heart of the expert

Mr A. J. Henley, MNZCS.
President of the New
Zealand Computer Society
1971-72.

Mr P. W. Harpham,
FNZCS. President of the
New Zealand Computer
Society 1972-73.

Dr B. G. Cox, FNZCS.
President of the New
Zealand Computer Society
1973-74.



In 1967 some founder members of Databank, Ted White (left) and Gordon Hogg (2nd from left), meet a deputation of British bankers to discuss decimal currency. Gordon Hogg remains general manager and Ted White was responsible as project manager for the construction and completion in 1985 of the Wellington Central Processing Centre.

The Wanganui Law Enforcement Centre became the landmark government computer development of the mid 1970s.

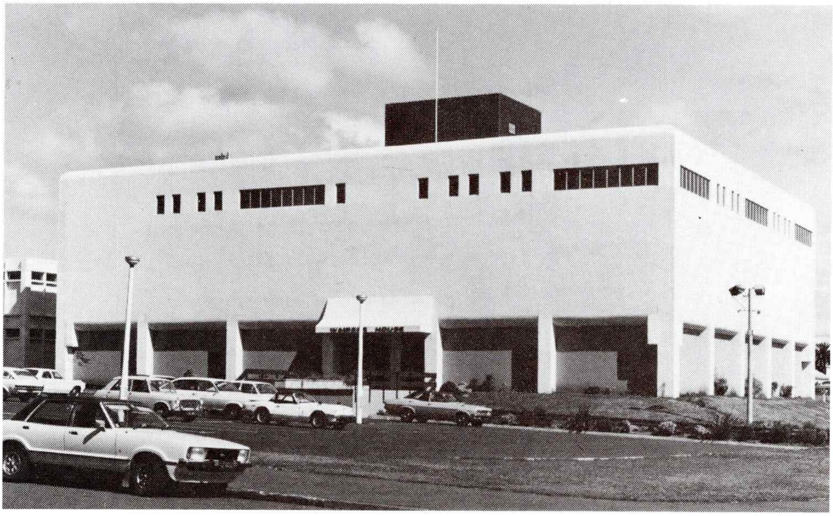


TABLE 1

SOME OPERATING EXPERT SYSTEMS

Field	Name	Use	Reference
Medicine	MYCIN	bacteria identification & antibiotics therapy	[SHO 76]
		Digitalis Therapy Advisor	[SWA 77]
	PUFF	Lung test interpretation	[KUN 78]
	INTERNIST	internal medicine diagnosis	[PMM 77]
	VM	iron-lung control	[FAG 78]
Chemistry	DENDRAL	identification of chemical compounds	[BF 78] [STE 78]
	CRYSALIS	structure of protein molecules	[ET 79]
	MOLGEN	molecular genetics	[FRI 79]
	SECS	design of organic synthesis	[WIP 74]
Mechanics	MECHANO	solving mechanics	[BUN 78]
	SACON	structural analysis consultant (for bridges, houses, etc.)	[BCEM 78]
Construction	DAMP	diagnosis of moisture damage in buildings	[SAC 85]
	COMIX	design of concrete mix	[MIL 85]
Geology	PROSPECTOR	mineral prospecting oil prospecting	[HDE 78]
Plant diseases		Diagnosis of plant diseases	[MC 79]
		Diagnosis of cereal crop diseases in NZ	[TUR 85]
Electric Circuit	EL	electric circuit analysis	[SS 77]
Programming	PECOS	automatic programming	[BAR 79]
	APE		[BOR 81]
	YES/MVS	computer operator	[KAR 84]

system. Graham Wrightson described it as the provision of a 'domain-specific reasoning system'. It comprises several parts. First there is the part which codes the information supplied by the enquirer (the situation data) into a form that can be matched with that held by the system (the knowledge base). Then there is the knowledge manager, sometimes called the interpreter, inference engine or logic engine, that takes the situation data and identifies that part of the knowledge base which is applicable. It then applies the programmed logic to work out the inferences from the matching pieces of data.

Computers are good at this sort of thing. It is relatively easy to program a computer in the form:

> If A is true then B is the consequence/take this action.

I hope none of my readers will have been the recipient of a piece of computer logic that goes something like this:

> If account is outstanding for over three months/and previous reminders have been ignored, then we have a bad payer send out a nasty letter.

The problems to be overcome by the authors of expert systems are two-fold and they present each of the partners, the expert and the systems designer, with a formidable challenge. On the systems side the problems can be quite simply stated – size. A computer program can relatively easily test all possible combinations in a game of noughts and crosses and will never lose, but no computer in existence can do the same for a game of chess. Clearly some method has had to be devised to bring processing within reasonable bounds and it is here that most effort in recent years has been directed. The so-called 'fifth generation' computers are going to help, indeed, one of the justifications for their development is their use in expert systems. Fifth generation computers are being designed to enhance the problem solving, inference making and man/machine relationships of the computer. Specifically they will handle 'knowledge' rather than 'data' as do our present-day machines. Most early work on fifth generation computers has been done in Japan and it is confidently expected that they will become commercially available in the early 1990s. We do not, however, have to wait until then, for today's computers are quite powerful enough to handle many useful applications. Special computer languages such as PROLOG (PROgramming in LOGic) have been developed. These languages are not concerned with manipulating numerical quantities but with expressing relationships. No distinction is made between a piece of factual information (i.e. data) and a piece of program. PROLOG statements may be regarded as constituting both the specification of the program and the program itself.

The contribution of the experts to the overall design is crucial. Somehow or other they must pass on their knowledge in a form that can be used by the programs. This can be a daunting task. It is one thing to be an expert but quite another to be able to articulate one's expertise in a coherent form, useful to the computer. While every possible circumstance and combination of circumstances that can occur must be envisaged and the consequences worked out in advance, not all logical combinations will be valid considerations and these can be eliminated. Furthermore, facts established in earlier lines of enquiry can eliminate possibilities when considering situations further down the chain. By identifying these cases early in the specification the expert can make the task of the computer designer that much easier and, in the ultimate, make the difference between describing a system capable of being handled by today's computers and one that can not. Again the consequence may not always be clear cut; there may be a number of possibilities and situations will arise where there are possibilities within possibilities. Having worked all this out the recommended action may not be to deal with the most likely first since failing to act on one of the others could have serious consequences should it prove to represent the actual case. Considerations such as these must be foreseen and also specified in advance.

The third area that we have identified is that of communication between the expert system and the user. The dialogue, and I have used that word deliberately, between the user and the system must be couched as nearly as possible in the everyday technical language of users and must be meaningful to them. Input is usually achieved by the user supplying standard data pertaining to the situation under consideration, followed by a series of questions and answers. The questions are supplied by the system as it identifies the additional information it needs to proceed. Output can vary, depending on the type of system, but typically it comprises either a diagnosis or a recommended line of action or both. There is however, a further essential ingredient. This comprises an explanation as to why the particular diagnosis or action has been chosen, providing sufficient detail for users to validate the reasoning, at least to the extent of their own knowledge and experience. Not only does this build confidence but it also guards against the possibility of gross error, due either to misleading information having been supplied, or errors in the system logic when faced with unusual circumstances.

The requirement for good communication between system and user will be self-evident but what is not self-evident is the complex programming and the amount of processing that is needed to achieve this end. Here, as in other computer applications, the more 'user friendly' the system is, the greater has been the effort that has been put into the system design and the more power will the computer need to run it.

To get a feel for what is involved let us look at designing a simple, very simple expert system – say 'Instructions for Crossing the Road!' We must all be more-or-less experts here or we would not be around to tell the tale. Probably the first instruction we received or have given to our children runs something like this:

Look RIGHT
Look LEFT
Look RIGHT again
If there are no approaching vehicles in sight
WALK (NOT RUN) STRAIGHT (NOT DIAGONALLY) ACROSS THE ROAD.

So far so good. But this may not be a very efficient system. For example the user could be waiting unnecessarily if the approaching vehicle is a long way away and travelling slowly. Again, if taken literally, it could be dangerous should a parked vehicle be obscuring the view. We will need to take these factors into consideration. But before we pursue this line of reasoning further, we should reflect a minute for there are other considerations that could make these enquiries redundant. What if there is a traffic officer present controlling the traffic flow or there are traffic lights? Then the cross or not to cross decision becomes a simple matter of whether or not we have been signalled to do so. Well not quite. This probably applies only to the case where the traffic officer is present. It would be safe, if perhaps not strictly legal, to recommend crossing on a quiet Sunday morning where there is not a vehicle in sight for miles around even if the lights say 'WAIT'. Again, what if there is a pedestrian crossing? Here the opposite is the case. While we may legally be entitled to step on to the crossing it would be imprudent to do so if it appears that an approaching car is travelling too fast and would be unable to stop in time. It would also show commendable courtesy not to insist on one's rights and force a bus to stop when our saving would be a trivial ten seconds at the most. Further, what if we are not at a pedestrian crossing but one is near? Well the road code gives some guidance here, saying that if we are within twenty meters of a crossing we must use it. But these rules could at times also be ignored in circumstances similar to those for traffic lights. There will, however, be other occasions when it would be worthwhile walking a greater distance than is prescribed in the road code instead of waiting for a break in the traffic flow.

There are several methods available to assist in specifying the logic of systems of which the so-called flow chart is probably the most venerable, its use certainly pre-dates electronic computers. Special variants have been developed for use with expert systems, but in its simplest form the initial part of a chart for our system might look something like that in Figure 6.3a. It will be observed that in both cases the chart leads us

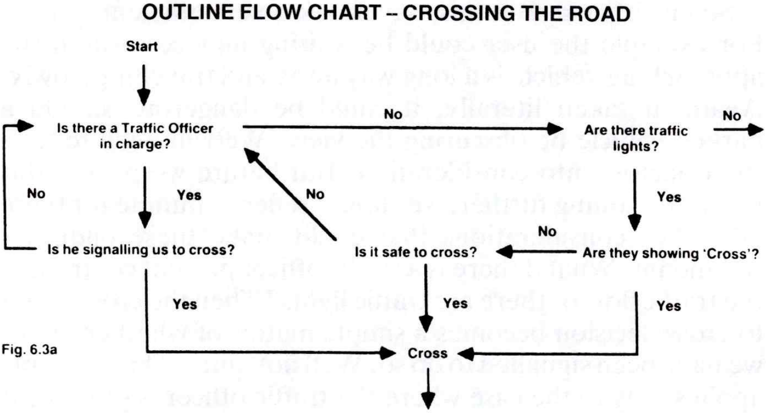

OUTLINE FLOW CHART – CROSSING THE ROAD
Start
Is there a Traffic Officer in charge?
No
Are there traffic lights?
No
No
Yes
No
Yes
No
Is he signalling us to cross?
Is it safe to cross?
Are they showing 'Cross'?
Yes
Yes
Yes
Cross

Fig. 6.3a

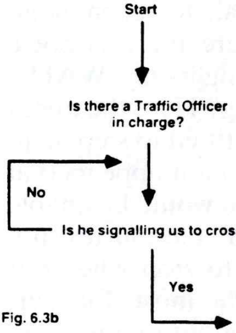

Start
Is there a Traffic Officer in charge?
No
Is he signalling us to cross?
Yes

Fig. 6.3b

back to the start point if the decision is not to cross immediately. This may, at first sight, seem unnecessary. It would have been wrong however to have drawn the left hand side of the chart as in Figure 6.3b. It is quite possible that the traffic officer might come to the end of his tour of duty and leave before signalling us to cross. In this case we would be left waiting in an endless loop or at least having a very long wait until the next time a traffic officer came on duty. Equally for one reason or another the control of traffic at our traffic lights may have been taken over by a traffic officer. He would not look favourably on our attempts to cross the street when he signalled us not to do so even if the lights said 'CROSS'.

These finer points are not always readily apparent if we write our specification in narrative form and some sort of logical charting is a great help in bringing considerations such as these to our attention.

A final point worth noting is that the question 'IS IT SAFE TO CROSS?' will need quite a lot more definition but we do not do it here. This is because we know that this question will also be used at other decision nodes in the chart. It is a 'sub-routine' and, as such, is defined seperately. When the program is running it will branch to the sub-routine when required, do the necessary processing, and then return. In this way the sub-routine need only be written once. In our case the sub-routine will contain amongst things the 'LOOK RIGHT, LOOK LEFT', etc we identified in our first examination of the problem.

Readers may care to extend the diagram a little further. Those who find this rather too easy may like to have a shot at writing some of the resulting programs. Here those who have access to program languages which specialise in this area, will find the task somewhat less daunting than those who have to rely on BASIC. Incidently PROLOG one of the languages mentioned earlier, will now run on some micro computers.

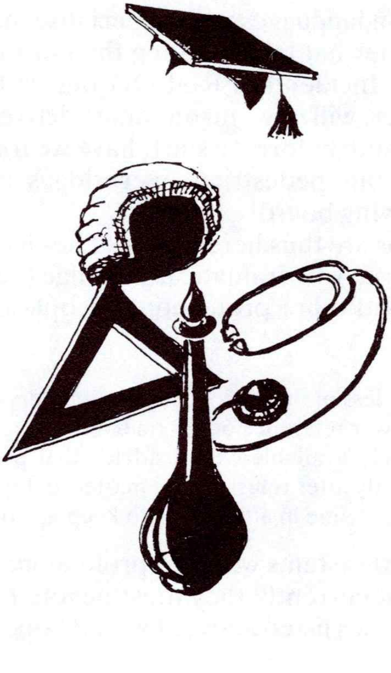
But, just a minute before we start, have we forgotten something? What about pedestrian overbridges and subways? Back to the drawing board!

Expert systems are thus here to stay. The challenge and the benefits that accrue will dramatically change the way our doctors, solicitors and other professional people go about their work. They will:

Need to commit less of their knowledge to memory.
Need to have fewer reference books on hand.
Have immediately available expert advice that previously had been obtained only after referring the matter to a specialist.
Need to spend less time in attempting to keep up-to-date.

The use of expert systems will save professional practitioners a lot of time that currently they must devote to the less than productive activities listed above. I would hope that, as a consequence it would also mean that they could then be able to spend more time on the human relations side of their practice. Could it be that once again general practitioners will get to know their patients when they are well and not merely as someone who has a medical problem? Or that the family solicitor will return to helping his clients deal with the not strictly legal but nevertheless worrying problems that beset all families from time to time?

As an additional bonus, expert systems will open up opportunities for New Zealand specialists, not only doctors and lawyers but also all those in fields where New Zealand plays a leading role, to pass on their skills. The computer industry is preparing to do its part. I hope, now that New Zealand is entering its second quarter century of electronic computing, that the professions will soon be seen to be doing likewise.



CHAPTER SEVEN

PERSONAL COMPUTERS

Selwyn Arrow

Selwyn Arrow joined the New Zealand Post Office in 1960 and has been involved in telecommunications since then. His introduction to EDP came when he was appointed as a lecturer at the NZPO National Transmission Training Centre at Hamilton in the late 1970s. He regularly contributes to computer magazines as a part-time journalist, is chairman of the New Zealand Microcomputer Club Inc and untiring editor of the club's magazine 'NZ MICRO'.

Just ten years ago an event occurred which signalled the start of a revolution that has now come to the notice of nearly everyone in this country. This event was the birth of the microcomputer. Aptly described as an extension to the human mind, this relatively small electronic device has developed so many capabilities in those few years that it has become the 'personal computer' we know it as today. Because it can be used to advantage in most homes and offices this general purpose, but personalised tool, has the power to change the way we live, learn and communicate. Perhaps most important in this context is that this 'new wave' in computing is able to provide the means of access from homes and offices to the most up to date knowledge that mankind has acquired.

The start of this new era of computing can be traced back to January 1975 when *Popular Electronics* magazine printed details of the Altair 8800 computer using a microprocessor chip as its 'brain'.

By today's standards this mail order computer kit was really crude but it was capable of computing functions that up till then were only possible by visiting a computer centre belonging to a university, a government department or very large business concern. Nowadays anybody can make use of their computer's power whenever they want to.

In recent years many people have discovered that the personal computer can be used in the home without special training. The personal computer, unlike its large predecessors, does not require staff to install, to program or to maintain. Within its small interior it has the potential to be a general purpose tool for making many small business, home or hobby activities much easier and more swiftly accomplished. Indeed many users have found it is a fascinating hobby to go on a voyage of discovery of their own computer, with its many and varied capabilities.

The original and alternative name for the personal computer was the microcomputer, this was because it was built around a microprocessor chip and was much smaller than, though not then as capable as, the fully fledged mainframe computers of that era. The production of the first 'processor on a chip' was an offshoot of the pocket calculator business, but several electronics hobbyists in the United States, soon realising its potential, started to build microcomputers for themselves. Hence in January 1975 the article on the Altair 8800 computer appeared. This mail order computer kit became an overnight success to the surprise and delight of its designer and it became the first in a line of commercially successful microcomputers. A variety of plug-in-boards soon became available including the first colour graphics board. The 'Dazzler' and its hypnotic 'Kaleidoscope' program achieved early fame in New York when left to run overnight in a shop window. The store owners were soon politely but firmly requested by the police department to shut it off as it was causing a major traffic jam to passers-by and traffic.

Microcomputing remained primarily a do-it-yourself activity until the first East Coast Computer Show held in Atlantic City in August 1976. It was then that the Apple I computer had its first public showing by its designer Steve

Jobs. He was very pleased to receive orders from dealers for twenty units so he went back to his garage to produce the Apple II computer the next year. At that same show when a new hobbyist computing magazine, *Kilobaud* was announced, it sold more than a thousand advance subscriptions. The first issue was mailed in November and so computing as a hobby began to spread. Less than six months later there arrived the first all-in-one microcomputer package that could be bought, plugged in and turned on, it was the Commodore PET 2001 and it was shown at the West Coast Computer Faire. The third well known microcomputer to make its appearance in those early days, the Radio Shack TRS-80 Model I was released in August 1977. By 1978, with the advantage of being sold through a chain of thousands of Radio Shack stores, the TRS-80 was leading in sales in the United States. By then it was no longer necessary to be an electronics hobbyist to cope with computers, they had arrived in the homes and hearts of thousands of people.

That was the United States where the story began, but what was happening here in New Zealand during that time? With the then customary technology delay we were a little slower getting going, mainly due to the difficulty of obtaining the necessary specialised components. But some New Zealanders were keeping up with the play.

In early 1977, after reading about clubs being formed in the United States for this new hobby of computing, Brian Conquer called together a small group of interested people in Auckland to form a club. Letters were sent to individuals and electronics firms and an inaugural meeting called for May: thirty-nine people attended and decided to call it the New Zealand Microcomputer Club. Members were invited from all over the country with the hope that other centres would continually form their own local clubs. National activities were to include publishing a national club magazine, the adoption of one microcomputer bus standard, and co-ordinating national activities.

In the main the members were technically oriented people with a sprinkling of mainframe computer users. All were keen to make and use their own microcomputers. In that inaugural year it was reported that visiting members of the Wellington Microcomputing Society were in agreement with becoming affiliated to a national body. But a later meeting was to report communication problems with Wellington and eventually the ideal of a national association of computer clubs was dropped. One original item that did continue was the club magazine, it is the primary link which has held the club together over the years. Although it faltered in some of those early years *NZ MICRO* continued to keep both Auckland and distant members in touch as it reflected the changes which occurred to both the club and to microcomputers. Today, as well as being sent to members and to major libraries throughout the country, *NZ MICRO* also sells in computer stores and bookshops.

One of the inevitable changes over the years was the move from the original build-it-yourself type of member of the first few years, to the emphasis the club and its members now place on the use of personal computers, a swing from hardware orientation to software and its uses. For instance, 1981 first saw the appearance of user groups within the club. By 1984 there were fifteen such groups, each specialising in different types of applications or makes of computers. With such a wide choice of groups under the club's umbrella the members can now participate in any group's activities for just the one membership fee. As an example, the Business User Group has members with many different makes of computers but they share the common interest of small business programs and their applications.

Such a diversity of groups also provides a membership strength which enables the club to tackle large projects. This is clearly shown with the microcomputer exhibition organised annually by NZ Microcomputer Club members on a voluntary basis. The first microcomputer exhibition was held in a school hall in late 1980 and about 800 members of the public attended this one day show of home and hobby computers. Indicative of the increasing public interest in personal computers, the attendance at successive exhibitions very nearly doubled in each of the following three years. By 1983 the much higher profile exhibition had moved to the Auckland Showgrounds, as there was nowhere else that could accommodate such large crowds. It was very much like holding a tiger by the tail and having it take off.

Micro Show '84 brought in an attendance of 8,500 people in just the one day. It featured fifty-eight commercial stands, the New Zealand Micro Club's more active user groups and seven other computer groups from the Auckland area. Special attractions were a maze complete with a Micro Mouse from the Wellington Microcomputing Society to 'run' in it, and a series of talks and presentations on personal computers which ran throughout the day.

The Club's original objective of showing personal computers and their variety of uses to the public at this annual event, has now become a worthwhile fund raiser for the club as well, enabling it to embark on other projects. One result was the purchase in 1984 of a business computer for club use. With a library stocked with well over 1,200 computer magazines and books, an efficient library system was needed, plus the essential task of updating the records of the 600 plus members. A more significant members' use for the club computer is the provision of a Computer Bulletin Board enabling them to send messages and programs over the telephone to the club computer for later access by others. This system started up in January 1984 with a commercial computer company, Attache Systems, generously donating time on their computer. They provided a dial-in line and members were able to test and suggest updates for the bulletin board software that had been acquired from Sydney. This facility became very popular with members of the various clubs and groups as well as the public.

The New Zealand Micro Club started their own Computer Bulletin Board System for members in 1985, with improved means of uploading and downloading programs, so that these could be shared by others. A large library of public domain software is now available from the club and several of its user groups. The ability to access the CBBS at a reasonable cost to users was not entirely due to the New Zealand Micro Club, one important item that made it all possible was the design and manufacture of low cost acoustic modems, which enable a computer to communicate over the telephone. The modem project was one long term result of a combined group representing all of the Auckland clubs and groups.

Formed in January 1982 the Combined Microcomputer Users Group was established as an informal body to provide a forum for communication between its member clubs and groups. The modem project was one such combined project. The Combined Microcomputer Users Group lasted just over a year but in that time the succesful design of a modem was presented and this item was the main means of communication until low cost commercial modems became available in 1984.

Longer lasting relations were established with many local and overseas clubs over the years with the exchange of magazines and newsletters. In particular the Canberra club MICSIG invited the New Zealand Micro Club to send their Chairman to present a paper on New Zealand software at their conference in August of 1982. The next year one of their members, Chris McEwen, was a guest at our club's exhibition. He then presented the club with a VIC-20 computer and this is made available for hire to members.

With the proliferation of user groups, many of them having their own meeting nights, the meeting venue was quite often found to be overcrowded so that late in 1984 the club initiated a search, for the third time, for a better and more central meeting place. As well as holding regular monthly evening meetings, since 1983 a monthly computer Saturday, for members to take along their computers, has been a popular activity. So much so that these were also organised for suburbs as well late in 1984, again with great success. For the last few years it has been realised by the club that it must not remain static and that it would need to continue to provide new services for its existing members as well as enticements to continue to get new members.

The Christchurch Microprocessor User Group was initiated in 1980 as a users' group for government and university scientists interested in microcomputer applications in agriculture. The first meeting in August was attended by representatives from DSIR, Lincoln College, Canterbury University and Christchurch Polytechnic. At that time information on microcomputers was hard to obtain and the group spent some time swapping information. It was felt that there was a need for those in the field to have a means of meeting each other, but that there was no reason to limit it to public servants. The first public meeting the next month at the Christchurch Polytechnic was attended by well over one hundred people and overflowed the room so it was necessary to shift to a larger auditorium. At the end of this meeting the group broke up into separate groups concentrated around specific microprocessors, and numerous discussions resulted. The group remained an informal one with annual dues of four dollars, mainly used to provide postage. A Board of Trustees was elected, but it was primarily a source of speakers for each meeting over the next couple of years. Despite a wide ranging set of interesting topics and the discussions which followed, the numbers attending began to dwindle.

One meeting's highlight was the demonstration of the HP-85 computer by a hapless salesman before an audience which knew a lot more about it than he did. As he went through the prepared list of features, he got to the part about 'all keys are soft keys'. After obvious puzzlement, he vigorously pounded the keyboard and said, 'See, it doesn't hurt my fingertips at all.' During this time active user groups dedicated to specific computers were formed in Christchurch. The Christchurch TRS-80 Users' Group was formed in early 1981 since members felt that they should be independant of the TRS-80 suppliers. When the System 80 started to arrive from Australia in mid 1981, the question arose as to whether the group should allow owners of Radio Shack 'copies' to participate? A decision was eventually made to extend membership to include any computer capable of running TRS-80 software and the name was changed to the CHRISTCHURCH '80 USER'S GROUP to emphasise this fact. This group now has a membership of 120, eighty percent of whom own a System 80. It continues to publish an informative newsletter and meets informally each month. At last count a dozen such independent groups were meeting in Christchurch.

The original group has not faired so well and the last meeting was on 10 November 1982, appropriately with a talk on Farm Management to commemorate their beginning as a workshop on Computers in Agriculture. In retrospect, according to Jay Mann the prime mover of the group, the Christchurch Micro User Group was formed to supply an information gap, and it ended when easier ways of obtaining information became available. The strength of the group lay in its range of members, able to speak about and to appreciate talks on a wide variety of topics. Most members seemed to prefer attending user groups devoted to specific hardware and to concentrate on their specific machines. 'I believe,' he said, 'that there still could be room for an umbrella organisation that would sponsor talks on more general topics. To some extent, the local branch of the New Zealand Computer Society performs this kind of service here.' It is an interesting contrast that this umbrella function is provided by the major computer clubs themselves in both Auckland and Wellington. In both centres, the local groups are communicating more now than ever before, as they each recognise the need to pool resources for mutual benefit in such projects as publicity and combined gatherings such as computer exhibitions. It could be that the Christchurch groups will again get together as the personal computer market matures, or the pendulum may swing away in the other main centres.

One thing is certain, the computer revolution we are experiencing is still in its relatively early days. We've seen it grow from the dedicated do-it-yourselfer of the first few years, to the mass production of what were originally considered to be only hobby machines. In the early marketing plans for the first TRS-80s for instance, it was considered to be of interest only to those who had experience with its bigger brothers, people such as programmers, engineers and perhaps scientists. As we now know the ready-to-run microcomputers quickly caught on, much to the surprise of some of the manufacturers. Many people found they were of great interest and, better still, of use to them in their daily lives. In most cases the designers themselves were caught unawares by the potential of such innocent looking devices, as their owners put them to use in their businesses as well as in their homes. Such are the makings of a micro revolution.

The personal computer can be looked at from many points of view. It's a device that can provide a lot of fun, it can be a time waster. It can save recalculating figures each time a job is done, it can drive some people away by its complexities or by its simple-mindedness, or it can provide plenty of opportunity for extending our knowledge of ourselves and our surroundings. In the last couple of years we have been bombarded by insidious advertisements, television programmes showing happy and satisfied users. Even friends and workmates who have taken the plunge join in. They all seem to have survived the experience more or less intact. For some this new toy is eventually shoved in a cupboard to be forgotten until a visitor arrives. While others rave on for hours about this wonderful new 'thing' in their life. How can an electronic device be so many things to so many different people? Nearly everyone who has had a chance to interact with one has eventually become infected with the personal computing malady and people seem to come up with an amazing range of uses for it.

Many home computers are bought for their games capabilities, and that may be all they will be used for. But some of us have other ideas. These include using it as a learning device, as a tool to get a range of jobs done, or as an aid to spare-time activities such as a hobby or community work. Then there are those who end up with it as a hobby activity in itself. Let us have a closer look at some of these uses to get an idea of how wide ranging a personal computer can be. Bear in mind that some of these activities do require add-on or peripheral equipment and the cost of these must be added to the original cost of the computer.

There are numerous entertaining and educational games available for all ages. These can be as simple as ABC, or as complicated as backgammon or chess. In buying a small computer for games there is the advantage of using it for many other functions as well when the games become too well known. The difference between a game unit and a home computer is getting more blurred all the time. By plugging a BASIC language cartridge, instead of a game cartridge, into some advanced game machines it is possible to have access to a range of computer uses. Of course there are games and games. Many sophisticated ones are actually simulations of air and space craft. An immense amount of work on simulation has been carried out by NASA and this has now spun-off into commercial pilot training and, of course, computer games as many enthusiasts will testify. Again some well-written games are designed to enhance or teach skills, such as hand-eye co-ordination, as well as provide entertainment.

Housekeeping activities can include keeping easily updated lists of household assets with descriptions for insurance purposes. Shopping lists can be printed out before going to the supermarket, and prices can also be included for cost comparisons. Perhaps one day it will be possible to do a stocktake in the cupboards with a bar code reader as is used in many supermarkets.

Recipe lists are another possibility. These can be handled in a variety of ways, such as indexed under fruit in season, or meals for five etc. Of course the really keen cook has been known to type each recipe in, but it has been suggested that a computer index or database of recipes is much more efficient as this allows recipes to be kept in existing folders and books. Anyway how would you include those delicious photos in the computer? Perhaps with Teletex we may be able to call up the recipe of the day and store it in the home computer but until then ... Family accounts and budget programs are fairly well established. But their usefulness really depends on what the program can offer. Kept accurately and updated regularly this can be a most useful function. The type of program most used in the home, apart from word processing, would involve itemising collections. Stamps, records, books, magazines, jigsaw puzzles, gems – the personal computer makes a useful adjunct to keeping an accurate record of all types of collections. Here a printer is a necessity as it is not always convenient to turn the computer on to consult a list and of course a print-out is handy to take along when making new acquisitions.

Not surprisingly there can also be pitfalls. Bringing the first computer into the home can be compared to having a first baby. It is eagerly anticipated but nobody realises just how time consuming or complicated it can be until it arrives. It can be fun, challenging, relaxing and at times most frustrating. It ends up growing, consuming money rather than food, it soon becomes part of the family. Like any new addition it can put a strain on family relationships, but once you have one you will not easily give it up, save on those days when it burps and messes up all you were trying to achieve.

When considering the purchase of a home computer, the family environment into which it must fit should be considered. Where should it be located, in the family room or lounge so that it can first use the television set? Or should a separate room be used and another television or monitor purchased? Will it interfere with other activities in the same room? The one point to sort out very early is just who will have priority after school, after work, during the weekends and in the evenings. Much frustration and disharmony can be avoided if a few simple rules are implemented when the computer is first introduced.

The use of microcomputers in schools is covered in the chapter on Education but the lessons learned there can be supplemented in the home. Obtaining skills through using a computer can begin at an early age. Preschoolers enjoy games and programmes that give a reward, such as a smile or a tune for a correct response. Co-ordination and manipulation skills are improved with many games. So is the child's perception of shape, colour and sound. With suitable feedback, such as with the teaching language LOGO, they are able to experiment artistically with mathematical concepts via the computer screen and learn intuitively what adults had to learn the hard way with pencil and paper. Playing computer games can mean children are unafraid of computers and keyboards. Their knowledge increases with familarity and confidence. Properly directed, their use of computers will allow full reign of their artistic creativity in many areas we are only just beginning to appreciate. A word processor at home can materially assist the older children with their homework tasks.

Many people obviously want to learn more about this personal computer and turn towards the computer magazine. In the United States alone there are more than 200 computer magazines on sale; one of them with a monthly circulation of 600,000. Different magazines vary in their approach, from beginners to heavily specialised subject matter, and the better ones keep their readers in close touch with the leading edges of computer technology and its applications. Less than half of overseas magazines reach our shores, but still their numbers grow, overflowing the shelves and crowding out other magazines. New Zealand has so far produced five magazines of our own, selling in total something like 35,000 copies per month. These home grown magazines suffer a little from having to cover a wider spectrum of computer uses than their overseas counterparts. With all these magazines and of course the vast range of computer book titles now being sold here as well, this adds up to a lot of interest being shown in the personal computer and its software.

Sooner or later most computer users get into the situation where they are stuck. Perhaps a problem arises in deciding what database program will be best for certain needs, or there is trouble getting that darned printer to work properly. Magazines are not much help here nor, in general, are sales staff much better. They simply cannot afford the time to acquire the in-depth knowledge necessary. Quite possibly they have not even had time to read much more than the glossy pamphlets. The first line of defence is the handbook that came with the computer. That is not to say that reading a handbook provides full understanding but happily the quality of handbooks is improving as the product matures. Gone are the days of Jenglish (Japanese English) and obscure technicalities in the user's manual – we hope.

When further assistance is required it can usually be found relatively easily, at least in cities and most towns. In many cases this is as easy as locating the computer club or user group which is involved with that particular brand of computer. A list of all known clubs and groups is printed from time to time in *BITS & BYTES* magazine or can be obtained from the New Zealand Computer Society. Computer clubs are not just for the fanatics, they cater for all, from prospective purchasers and beginners, to those with experience and the willingness to share. Many of their members have trodden the same path that newcomers to personal computing are considering and they are more than willing to give assistance by sharing their experiences and knowledge with new members.

An area of immense potential for the personal computer owner is the use of his machine to access the growing number of public databases containing information on subjects of every kind. Even now the two standard household communication items in this country are undergoing a change to enable us to increase our personal communication facilities. The first is the television set, the second is the telephone. Viewdata enables television to be used as a direct information gathering device, rather than just for entertainment. This information continuously transmitted along with your favourite television programmes can be displayed at will.

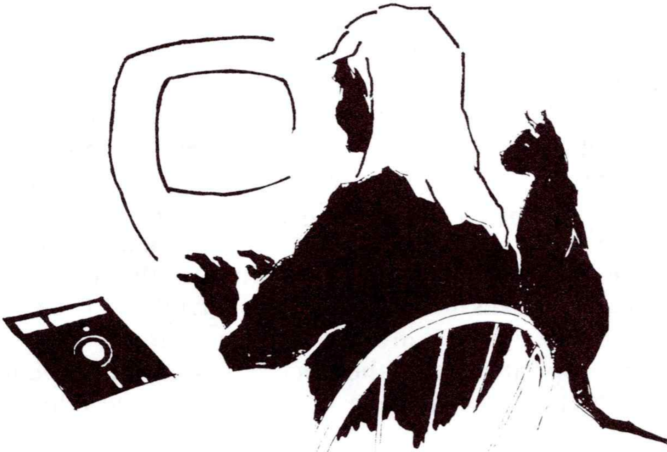
So far this information cannot be easily saved as required but eventualy we should be able to capture it with our home computer for storage and later use as necessary. Far more flexible as an information gatherer is the combination of telephone and television. Teletex services, as these are called, allow us to select at will from a broader range of information on a variety of computer databases by means of our telephone and a suitable terminal. At least two popular makes of personal computer have the capability to work this way and more are sure to follow. The requirement for keeping reference books and encyclopedias that are outdated before appearing on your shelves will be gone, when you can dial-up information that may have been entered in the database only minutes or days before.

The concept is not without its difficulties of course. There was the case recently of the person who studied dolphins. He subscribed to a news service in the United States and received a lot of information and references on this subject via his computer. But at certain times of the year he also received baseball scores mixed in with it. This had him thinking, until he realised he was getting the scores of a team called the Florida Dolphins. Computers still have a way to go yet before they can match humans in lateral thinking.

I see such communications coming of age when we can all have a set of subject selection filters on our household computer, so that we can then read our own personalised news over breakfast. Then in the evening we can catch up on more wide ranging follow-ups, including specialised items relating to our activities and hobbies. The use of the home computer for the disabled is another area with well-nigh unlimited potential but this is a subject in itself and I will leave it to be discussed elsewhere.

The personal computer is rapidly changing the world as we know it. We are familiar with it producing words and data on a screen or on to paper and we have probably heard of computer speech. But given the right add-ons and programs, computers are now starting to move about, use a silicon chip to see with and even understand the spoken word. The next development for computers as a hobby is robotics. Thousands of robots are currently used in factories and laboratories to do work considered too dangerous or unpleasant for humans and it may well be that they will also find a use in the home some day. In any case this is an area now under a lot of study and one which is being eagerly followed by some hobbyists. A limited number of simple robot models have made their appearance here recently. They are controlled by an inbuilt computer, and have a range of functions, including speech. Only last year a well known American magazine published details on using a 'seeing' chip that can be used as a simple camera or robot's eye. A lot of research is at present going into an efficient 'listening' program that can understand a range of human speech, so that we can eventually do away with having to use our fingers to input information into a computer. Some business computers already have a limited speech input capacity but it is still not yet possible for anybody to speak and have a personal computer recognise their meaning. It will be available to some extent within the next ten years and then we will be able to communicate verbally with our personal computer.

The word, computer, means different things to many people. Once most of us only had contact with one when the computer produced bills arrived. Now computers are infiltrating our homes and businesses. Soon, they may well be as indispensible to us at home as they are at work. They have the potential for many functions that are presently beyond our wildest imagination. As mentioned earlier personal computers can be an extension of ourselves, especially our minds. Given the right conditions we can use them for many functions, some good, some bad and some just time wasting. With their help many people are now accomplishing an ever widening variety of tasks that were previously considered too time consuming, boring, or just not worth-while doing. Of course not everything can be improved by using a computer, like most objects they have their limits, even if we have not found them all yet.



CHAPTER EIGHT

COMPUTERS IN EDUCATION

C.J. Potter

Chris Potter has experience both in teaching, including three years at a secondary school, and with the computer industry, having worked for IBM as DP Manager for Hamilton Medical Laboratory and as Systems Manager for the Waikato University. He has a long standing interest in computer education, and has been a convener of the Computer Society's National Education Committee, a member of the Vocational Training Council's Microelectronic Technology Advisory Committee and chairman of its EDP Working Party. He holds a B.Sc. in Physics obtained at the University of Canterbury and is at present Director of Computer Services, Waikato University.

The New Zealand Computer Society has always committed a healthy proportion of its energies to Education. This is to be expected in a young industry in which rapid growth and constant change are the norm. In the first place, it was clear that the existing educational system was going to have to meet the demands of the new technology and the Society recognised from an early stage that it could assist with the establishment of appropriate courses and syllabi. Before long the demands of its own members for seminars to keep them up to date forced the Society to place more emphasis in this area. Now, as the Society moves into the business of membership examinations, a further level of involvement is required.

It is appropriate in this the Society's twenty-fifth year to review the changes that have taken place in the education scene in those years, to note some of the contributions made by members of the Society and to look forward to the next twenty-five years, using what signposts we now have.

This review begins with the universities, since they were the first major branch of the education system to become involved. Universities recognised the need for computers in their teaching and research in the mid 1960s. Initially, their use of computers was mainly in the heavy application areas such as Engineering, Chemistry and Mathematics. In the early 1970s, computer science departments were established, in many cases to take over the load of service teaching, as well as to concentrate on computing in its own right. In the past fifteen years the computer science departments have expanded enormously in size, and computing has become the most pervasive subject within the universities.

At the outset, computing teaching in New Zealand tended to be divided into service teaching (often subdivided into two groups; science and commerce) and Computer Science per se. The latter group started off small in size, producing graduates with a good knowledge of systems software, languages, and hardware but with little exposure to commercial applications. The service group has expanded dramatically, particularly during the last few years, and in some universities is no longer taught by the Computer Science departments.

Whereas initially, service teaching concentrated on elementary programming, the emphasis now tends to be much more on using computers and exploring their potential. Most students now have had some exposure to computing prior to coming to university, and are looking to wider applications. The more specialized computer science group has also expanded in recent years, and shifted in its attention. Programming skills are still paramount, but Computer Science teaching tends to concentrate on Pascal and its derivatives, with COBOL relegated to specialised business oriented courses, and FORTRAN left to the scientists.

As to the actual use of the computer hardware installed in the universities, this has been dominated by the traditionally 'heavy' computing departments of Mathematics, Science and Engineering. More recently Business or Management Studies departments have emerged as major users of computer resources, reflecting the demands of modern business. The recognition of the value of computers as teaching aids (teaching 'with' in contrast to 'about' computers) has led to their widespread use throughout the institutions, with most students now finding themselves required to use an interactive 'workstation' at some time in their stay at university. Another recent development to emerge has been the use of the computer by staff as a filing system and general organisational aid. Personal bibliographies are now commonly kept on the computer where they can be added to by secretaries or students and readily searched, sorted and printed. The Word Processor is a natural adjunct to this development and together these tools are improving the productivity of academic staff, enabling them to spend more time on their teaching and research.

Technical institutes have also been responding to the new technology. The first courses, evening classes covering mainly introductory topics, started as early as 1966, and a 1967 prospectus made the tentative statement; 'It is probable that simple programs will be written and that an opportunity will be given for these programs to be used on a computer.' In the following year the same prospectus made first mention of COBOL and FORTRAN. It was during this period that the decisions were made which were to set the directions for the years to come; namely, that training was to be provided for identified vocational occupations in the business and commercial community. This emphasis has been maintained to the present day, and has proved to be a most successful formula. However, it was not until 1972 that the NZ Certificate in Data Processing was established, providing a national standard and structure.

In the early years the technical institutes were obliged to take staff and hardware where they could find them. Typically arrangements were made to second lecturers from the larger vendors for periods of a few weeks, and hardware was donated – after first serving a useful life with a business firm. Student jobs were run on computers belonging to local businesses. The first processor supplied to a technical institute by a government grant was installed in 1978 in the Auckland Technical Institute, and it remained the only one until a block purchase in 1982, which saw all the larger institutes provided with mini-computers. In the years since those first evening classes were held, not only has the number of Computer Studies courses increased dramatically and the equipment available improved immeasurably, but also computer-related topics have filtered into a large number of other areas. For example, accountancy courses now have a large component of such studies, computer hardware technicians are being trained and computer control is studied in many industrial applications.

Our schools have been somewhat slower in getting off the mark. Very few secondary schools were able to afford their own computers until the advent of the microcomputer in the late 1970s. Many had offered some courses in programming before then, mostly by means of hand-punched cards processed by arrangement with local computer centres. The most widespread of such arrangements was with Databank Systems, which operated a service for schools throughout the country on its network of processors.

The acquisition of microcomputers by secondary schools has not been easy. Indeed it has been marked by controversy and confusion. Growth in numbers has been quite rapid, rising from fewer than 100 in 1980, to about 2500 in 1984. More significantly, ninety-six percent of secondary schools now have at least one microcomputer. Despite this there is a wide and growing variation in facilities between schools, both in numbers of computers and in the nature of their use. This disparity reflects the scarcity of computer-knowledgeable staff in all subject areas as well as the difficulties faced by many schools in obtaining the relatively large funds required to purchase a set of microcomputers.

An attempt was made in 1980 to identify key areas and to set priorities for computer use in secondary schools, with the

New Zealand Computer Society representatives playing a leading role. The suggested priorities, which still apply, were:

> Computer awareness, for all students;
> Computer studies, for upper forms;
> Computer aided learning (CAL), at all levels across the curriculum especially for remedial work, with handicapped students, and for enrichment;
> Teacher and school administration.

Similar priorities were arrived at by the Consultative Committee on Computers in Schools, reporting in 1982.

The computer invasion of primary schools is only now getting under way. The first survey of use has been carried out by the Department of Education, and early indications are that no more than one school in three has its own machine. There is still a lack of clear guidance on the capabilities of computers and their value in teaching at this level, but as noted below there is a commitment to remedying this shortcoming. It is clear that priorities will be different from those for secondary schools.

If the finger is to be pointed at government education institutions for being slow to respond to the needs for computer education and training, the private sector is not in a strong position to do so. Some training centres have been set up either to provide 'in-house' training for larger organisations or as businesses in their own right, with the aim of introducing practical business-related principles and disciplines so that graduates are better suited for immediate productive employment. But such centres are few and far between. As a general observation it would be true to say that employers have consistently avoided the expense of the initial training role, preferring instead to employ staff with experience gained elsewhere, notably in recent times from government computing facilities.

The New Zealand Computer Society has been acutely conscious of the problems facing those engaged in computer education and one of the first national committees to be formed was an Education Committee. It is still active today. The Society published a Position Paper on Education and Vocational Training in 1981 and republished it in 1983. This paper covered the whole range from primary to tertiary and continuing education, suggesting priorities and syllabi. In it the Society emphasises the need for urgency, recognising that failure to act would cost New Zealand dearly, both in social disruption and through the inability to take full advantage of the opportunities offered by computer-based technologies.

Not content with publishing a Position Paper, the Society has been very active in implementing its recommendations as the following highlights attest:

- ✻ Involvement in the establishment in the technical institutes of the NZ Certificate of Data Processing and active participation in subsequent syllabus reviews.
- ✻ Involvement in the more recent establishment of the NZ Certificate of Computer Technology.
- ✻ Publication in 1978 of 'Computer Education in NZ', an exhaustive survey of courses offered by education and training organisations throughout the country.
- ✻ Numerous activities related to the rational introduction of computers into schools, including active membership of the Consultative Committee for Computers in Schools; sponsorship of the publication of 'Micro Which?', a guide to the personal computer market for educational applications; financial and active support for the establishment of the regional Computer Education Societies which recently formed a national body, the New Zealand Computer Education Society.
- ✻ The donation of prizes to be awarded each year to outstanding students at technical institutes and universities in computing studies.
- ✻ Active membership of the Vocational Training Council's Microelectronic Technology Advisory Committee (METAC) and its EDP Working Party. The latter has sponsored some significant research work in the field and recently commissioned the first DACUM conference, as described later in this article. As a direct result

of the Society's initiatives, a new body, the Information Technology Training Committee, is being set up, replacing METAC and having greater industry representation. This committee will also have a more direct influence on courses, syllabi and policies.

- As to continuing education and professional development for its own members and for the wider computer industry, the Society has always placed great emphasis on such activities. A New Zealand Computer Conference has been organised by branches of the Society every two years since 1968, with special seminars and workshops on various subjects being featured when appropriate. In 1983 the position of Director of Continuing Education was established to improve the co-ordination and presentation of events and the Society is now running a comprehensive continuing education programme.
- The Society is in the process of establishing a membership level based on examination and experience. With this move the Society is obliged to take an even closer interest in the courses available throughout the country with a view to accrediting appropriate ones for membership advancement purposes. Courses will cover all aspects of the profession including programming, systems analysis, operations, industrial programming and hardware service engineering. This should be a two-way process, with educators co-operating with the Society to design syllabi which meet the perceived requirements of the computer industry.

Commitment is a word that appears frequently in studies and recommendations in the area of computers and education, often sought but seldom given. The Consultative Committee on Computers in Schools, after recommending that the government should take steps to implement a comprehensive policy of computer education without delay, appealed for a major commitment to teacher training in any such policy. And of course it recommended a major financial commitment to support the introduction and sustain the continued operation of a total programme of computer education and use in schools. Ministers of education seem to have taken these calls seriously but the final act of commitment has been missing. Perhaps this is changing. The present minister has announced his government's commitments both to developing programmes for the provision of computer awareness in primary schools and to ensuring that every state secondary school is provided with adequate computer facilities and support. He has outlined a programme of development which will, amongst other steps, develop computer courses in all teachers' colleges. The outcome of the programme is intended to be a nationwide policy for the use of computers in primary, intermediate and secondary schools.

The education system must move to accommodate the rate of change accompanying (and sometimes brought about by) the introduction and use of the computer. The long-awaited plan of action must start with the teachers' colleges and In-Service Training for the teachers themselves.

Schools, both secondary and primary, must press for the formulation of a co-ordinated plan for the introduction and use of information technology in education. A start has been made with secondary schools, but it is no more than a start. Schools are going to be invited to submit proposals towards a national policy, but the challenge is not merely to catch up with today's technology but to prepare for tomorrow's. It is to be hoped therefore that the promised programme of research is spread as widely as possible, to include those with a knowledge of longer-term global trends in information technology, as well as an appreciation of their significance to education in this country.

Adult education must also be attended to as a matter of urgency. There seems to be an almost insatiable demand for short courses, ranging in level from the basic introduction of hardware concepts and capabilities, to specialised application courses in topics such as word processing, spread-sheets, databases and business applications. What courses there are have often been established in an unsatsifactory ad hoc manner by people with widely differing levels of knowledge and experience.

The power and potential of information technology – the combination of computer and communications technologies – are being increasingly realised. Access to files of information of all kinds, and the need to be able to use them, suggests in turn the need to concentrate on the study of information itself: searching, ordering, selecting, recognising pattern or structure. These techniques are fundamental, more important than the knowledge of computer languages themselves. Once the various educational requirements are recognised there remains the problem of how best to provide the equipment.

There are many reasons why New Zealand should focus on – and commit itself to – the production of computer-based educational resources. As noted in a later chapter there is the potential for a whole new industry here, including the provision of computer software tools to assist teachers in preparing their own programs, the recording of information databases, the designing and publication of 'courseware' and the development of techniques for using the whole range of electronic hardware, such as video disk-based devices and other specialised equipment. Such resources will be of value not only within New Zealand, meeting our needs without spending overseas, but also outside the country, suggesting both trading opportunities and assistance to our Pacific Island neighbours. The recently formed Wellington Region Learning Industry Development Association is an example of the growing recognition of the potential in this area.

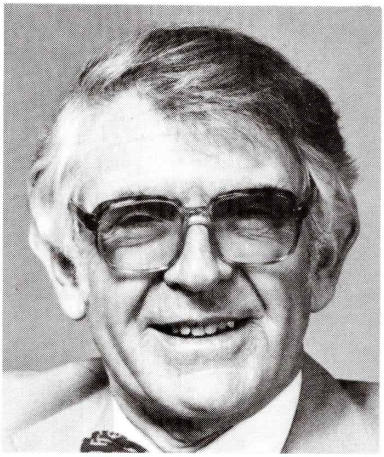
There is no doubt at all that the computer industry will keep growing in many directions for the foreseeable future. Growing vigorously alongside it, the information industry will continue to open up new horizons in access to information for all walks of life. The general directions and concerns already noted above will continue to apply: in other words, more of the same. However some developments now taking place point in quite new directions of growth or change. Four such 'signposts' are presented here. They are:

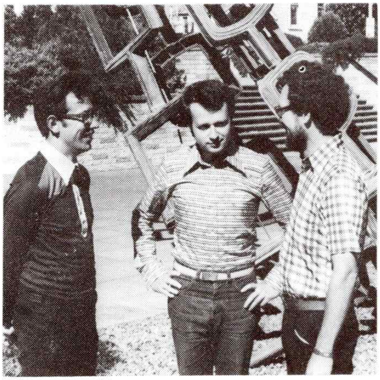
Helping to decide what to teach our up and coming computer practitioners.

Dr J. V. Robinson, FNZCS.
President of the New
Zealand Computer Society
1974-75.

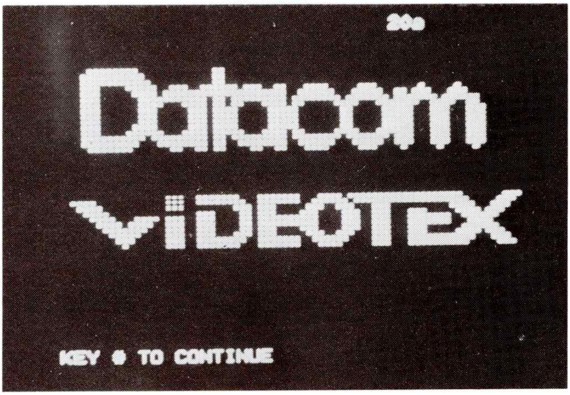
Mr G. J. Barnard, MNZCS.
President of the New
Zealand Computer Society
1975-76.

Mr T. A. Scoular, FNZCS.
President of the New
Zealand Computer Society
1976-77.





New Zealand has gained pre-eminence in advanced programming techniques. In 1977 this group of international programming specialists gathered at the Ministry of Works as part of an international research scheme to develop natural language programming.



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Datacom

VIDEOTEX

KEY # TO CONTINUE

DATACOM, starting life as the Christchurch firm of CBL, became a pioneer in the introduction of videotex in New Zealand, opening the first closed user group immediately after the inauguration of the Post Office video-tex access switch in 1984.

John Williams (left), managing director of Marton's PEC, shows some VIPs around his factory. PEC has gained an Australasian-wide reputation for its digitisation of petrol pump read-outs, security systems, and more recently for microprocessor controlled measurement recording systems.

The use of computers in teaching our primary schoolchildren.
Moving from computer professionals to information professionals.
Helping the work-force to adjust to the changes being brought about by the new technology.

To conclude this chapter let us look at each of these signposts and consider its implications for the future.

The problem with so much of the research into computer education needs is that it is either based on information from the wrong people or is out of date by the time it is published, or both. The DACUM (Developing a Curriculum) process overcomes these objections. The core of DACUM is the Conference. A typical DACUM Conference involves about a dozen representatives of the occupation under study, with one or two facilitators. Participants are carefully chosen to represent a practising cross-section of the workforce. They participate in a brainstorming session lasting three days, at the end of which they have produced a skill profile chart, which is subsequently validated by a number of people in the field to ensure that it represents current needs. This is in turn used as the basis for developing appropriate education and training courses and reviewing existing ones. Since the whole process can be completed in a few weeks, this signals a real breakthrough for educators and therefore for the future.

The first DACUM on a computer occupation in this country has just taken place. The spotlight was on programmers, and the participants covered the full range: large and small installations, commercial and scientific applications, COBOL, Fourth Generation Languages and all. The chart of skills they came up with and their associated priorities would raise some eyebrows, but it is here and now, and that is the aim. The validation stage is about to take place, giving some 120 practitioners an opportunity to comment from their different perspectives. The final report will then be available, within three months of the DACUM Conference. It should yield the most authoritative information yet obtained on the detailed skill requirements of an occupation within the computer industry. Let us hope that the education system takes up the challenge! More DACUMs in the computer area are planned, so that perhaps we may now look forward to a time when the industry, having been consulted throughout the process, is satisfied with the relevance and responsiveness of the various branches of the education system.

The long-term and educationally most significant factor in primary schools, is the growing awareness among teachers of the tremendous potential of the computer to improve the quality of children's learning and, indeed, to provide children with quite new sorts of creative, decision-making and problem-solving experiences. The areas of greatest potential educational gain at present are simulations, word-processing and programming.

A simulation can involve a group of children in a situation imitative of some aspect of real life, in which the children will 'succeed' only by making 'wise' decisions, based in large part on their developing understanding of the simulation's underlying logical structure. A well-designed simulation can engage children in a high quality co-operative thinking and discussing exercise.

A word-processor can motivate some children at least to increase the quantity and quality of their written expression. In addition, through writing more and through editing, children can improve their reading skills.

Programming, in its widest sense, is an area with great potential for enhancement of a child's learning. In the context of computing at the primary school level, it is perhaps most useful to consider children to be engaged in 'programming' whenever they are 'teaching' the computer to do something – whether it be to play a tune, draw a picture, move a robot, 'talk', or perform some 'difficult' calculation, such as finding the sum of all whole numbers up to any specified number. It is in programming that children have the greatest control over the computer and over their own learning, the highest level of creative experience at the computer, and the most fun.

There are now languages which have been developed to meet this particular need, a good example being LOGO, which was specificially designed for the purpose by Seymour

Papert and his colleagues at the Massachusetts Institute of Technology. Although a sophisticated, general-purpose programming language, LOGO has an introductory Turtle-graphics sub-language which is understandable even by very young children, but which can let them experience all the essential power and elegance of the wider language as they mature. Another approach is that adopted at the Wellington Polytechnic for the NZ Technical Aids Trust where the children are presented with material which they can react to and use as a basis for practicing their creativity. Both introduce children to a rich environment where they can explore numbers, words, shapes and patterns. More than that, they are provided with unique experiences in setting themselves challenging, interesting tasks and carrying out these tasks to their own satisfaction. This involves the children – necessarily – in logical thinking and – inevitably – in learning from their 'mistakes': educational goals not otherwise easily achieved.

The computer has tremendous potential to add positive, qualitatively new dimensions in teaching our primary schoolchildren, both for the gifted, the average and those with learning difficulties. Not only does the computer, as noted above, allow children to proceed at their own pace but also it has two admirable attributes, infinite patience and the complete absence, when programmed correctly, of any judgemental attitude. We have only just begun what should be an exciting adventure in educational exploration. So far the enthusiasts have forged ahead despite all the difficulties – such as lack of financial support and a shortage of high-quality educational software. This has been a healthy, grass-roots movement, but it is time for teachers and schools to be given greater guidance, support and encouragement.

Turning from primary education to the future needs of the industry we remember, as Tom Stonier has pointed out, that an 'Information Society' has an 'Information Economy'. This means that information becomes an item of real value. Those who can acquire it, store it, retrieve it, improve it and so on, will have an advantage over their competitors. People who can do these things better than others will therefore be crucial in obtaining and maintaining advantages in the market place for a whole range of goods.

In the future therefore we will need not just 'computer professionals' (people who understand the technology), but also 'information professionals'. These people have been given all sorts of titles – 'information professionals', 'knowledge engineers', even 'applied philosophers'! Their task will be to analyse what information needs to be kept, what form it should be kept in, how it can be accessed, how its accuracy can be checked, and so on.

Though they will undoubtedly need skills in computer technology they will also need a range of other skills: general skills in formal subjects (logic, linguistics, statistics, etc); systems design skills; professional skills; a knowledge of the activities of the user and so on. There is indeed a challenge here to our higher education system. Topics taught in subjects such as Philosophy, Psychology and Education are suddenly being found to be highly relevant to tomorrow's needs. To span the gap between these subjects and more traditional ones for computing professionals (e.g. computer science and mathematics) poses a real challenge. We require not only students with interests and abilities in both areas, but enlightened administrations who will allow programmes of study that cross many traditional boundaries.

Finally, turning to the introduction of the computer into the work place, we find another well known author, Alvin Toffler, in his book *Future Shock* pointing to the particular problems caused when technological innovation has to be absorbed in a period of time shorter than one generation. No-one expects today's school-leavers, (if they get jobs!) to stay in one career until they retire. Many jobs that were coming into existence twenty years ago have now all but disappeared (e.g. job control clerks and keypunch operators). As a society we have not come to terms with this yet. We still think that the education we receive when young will set us up for a lifetime of work.

The introduction of paid education leave into industrial awards would be a positive step towards coping with this situation. Very few workers in New Zealand have, at the time of writing, any expectation of paid education leave but it is likely to become commonplace as its wide-ranging value to the community is recognised.

There is much debate over the question of whether new technology increases or decreases job skills. The answer depends on how much training and education the operators receive. A person who is told nothing except which keys to press has become deskilled and will probably do the job poorly as a result. A person who has received some general education and training should be more able to understand the meaning of what they are doing and therefore be able to use initiative. This not only improves their morale, but will also improve the overall quality of their work. Paid education leave is essential in a modern egalitarian society such as ours. It is essential both for people and for the economy. But before it can be implemented effectively there must be, available throughout the country, courses in new technology that are relevant and useful to working people.

Many other trends could be identified and the corresponding educational problems highlighted. The most important point is that the urgent need to address and solve the problems is now recognised and the necessary resources must now be made available. Perhaps then the story of the second quarter century of computers in Education in New Zealand will be one of vision, commitment and achievement.

CHAPTER NINE

THE SOCIAL IMPLICATIONS OF COMPUTERS

Paul Bieleski and Jim Higgins

Paul Bieleski, a national councillor of the New Zealand Computer Society, has had a long involvement with computers, both teaching at university level and as a systems analyst/engineer with IBM. He is now operating a consulting agency from his home on the Coromandel Peninsula.
Jim Higgins, Deputy President of the New Zealand Computer Society, is Data Processing Manager of the Palmerston North City Council. He has been very active in Computer Society affairs and, with his special interest in education and training, is the convenor of the Society's National Education Committee.

Technological innovations have always had their social effects. From the wheel to the steam engine, changes in society have come about through the adoption of new technologies. The advent of computer technology, and the associated advancements in communications technology, are likewise having an all pervasive effect akin to, if not exceeding, that which followed the introduction of electricity. It is a technology that is not directed at a specific area of human affairs but has an impact on all aspects of our life.

Even before birth we will come under the influence of computer technology. Health workers use computers to a considerable degree in their work. This means that each child being born has a considerable backup system ready to go into action if the birth is not normal. Later, life support systems use the micro-processor to monitor the critically ill patient and many people alive today can thank this sophisticated technology. There are some, however, who believe that by interfering too much with natural mortality and the process of natural selection the genetic base of the population will decline. Micro-processors which help keep people alive, would then be playing a part in the general decline of the human species.

The child grows and develops. There is an education system that has been built to help in this developing process and computers are involved here. As human knowledge and experience increases, the difficulty for an individual to be knowledgeable about the world increases. Society over the years has had to pay ever more attention to formal systems of schooling, to accelerate the acquisition of the necessary knowledge and skills required to participate in society. It is quite apparent that in recent times schools, in their current form, are experiencing great difficulty in adequately preparing their pupils for the future.

Because of the costly nature of schooling, the systems used in schools have lagged behind the state of the art. The extraordinary communication medium of television has been slow to find a role in the education process. Computers provide a tool that has potential in education also. Computer suppliers some time ago saw possibilities when time-sharing computer systems were developed but had to await the advance into micro-processors to make the direct use of computers in education feasible.

While there remains a residual push to use time-sharing computers in education, the micro-processor is now leading the way. These small computers with a display unit can present material to a student and test the student's acquisition of ideas and knowledge. The computer has the capability to determine what material should be presented next. Follow-up material or revision material can be displayed according to the answers obtained from the previous computer questioning. The important thing is that the education program can be individually tailored to the person receiving the information.

Teaching programs have developed to the point where the student can be closely involved in the subject, using various means of computer simulation and modelling. The student can be exposed to a more realistic environment than with traditional forms of schooling and at much less cost. The computer can store any number of separate education programs which can be matched to individual needs. This means that the straight-jacket of traditional schooling can be broken. The computer can enable learning to take place away from the classroom and at a rate and time appropriate to the individual pupil.

In fact learning will soon become a lifelong hobby, with computer learning programs on just about any topic under the sun available from libraries. However one of the risks is that the learners may become isolated and lose interpersonal communication skills. The computer simulations could be so sophisticated that the real situation becomes ordinary and unrecognisable. There is also a possibility that this medium can be used as a way of propagandising a particular point of view. To counter this it has been suggested that academic learning could take place at home using the computer, while schools become a place for social and sporting activity.

As a person matures and gets involved in the affairs of society, the computer will continue to make its impact. The mere act of shopping brings about interaction with computers. Where a purchase is made on credit, a computer can be used to verify credit-worthiness, and a computer is more than likely to have been used to send out the bills.

Computers are involved in 'point of sale' machines that price goods and arrange for stock replenishment. Payments are more often being made by credit cards which depend on computerised banking facilities to keep track of debts. Already there are computer links that allow a direct transaction from a person's bank account to the supplier where a sale is made. Sooner or later most shopping will be able to be done from home, using television sets for the selection of purchases and the computer for the mechanism of buying. Money in the form of notes and coins will lose much of its present purpose and people will need to be vigilant to ensure that the funds transferred out of their account were correct.

Quite apart from the convenience, facilities such as these should bring down the merchants' overheads and be of benefit to most. The danger lies in such systems becoming unduly dominant and thereby disadvantaging those who are unable easily to demonstrate their credit worthiness.

Those involved in sports will find that fixtures, matches and scores are being organised by computer systems. Already clubs make use of computers for keeping their membership records and mailing list and sending subscription notices. Participants in sports such as sailing and flying will depend on computers for advice on the best course and the optimum trimming for their craft. Is it possible that over-use of computers in leisure will reduce some of the fun? If a person has legal dealings then computers are involved. The lawyer will have an 'Expert System' to help him in his research, and uses a computer to produce his bill or look after trust account moneys. The Police and Justice Departments now link into their computer for all their information needs. If you have any reason to be stopped by police, they will have the use of a portable computer terminal to display any Police Department information held on you, on the spot. The same will apply for traffic officers.

If a person is handicapped then the computer will play a very important part in his or her support system. New Zealanders, in such organisations as the Technical Aids Trust, are already bringing computer technology to the service of the disabled. For the blind, the computer will be able to assist with such tasks as reading documents, and as a speaking typewriter. For the deaf, a computer system will translate the unheard words into text displayed on a computer terminal or television screen, while for others with partial disability it will provide greatly improved hearing aids even to the extent of using implants to by-pass defective parts of the nervous system. For those who are immobilised the computer will be able to act as arms and even legs and, for the severely disabled, provide the sole means of communication with the outside world. The computer will be a useful, untiring slave in many different forms.

For someone who wants to be involved in public affairs, the computer will prove a boon, whether it is an individual or a public body researching a case to be made on some issue, preparing submissions, organising fundraising, or mobilising public support. Computer and communication links will enable more participatory democracy by allowing popular views on any topic to be fed to the decision makers. The trend for open government will enable anyone to seek out public documents from a government data base computer using a private computer in the home. Computer software in the form of 'expert systems' will enable activists to do battle with technocrats on an equal footing.

There is another side to this that concerns some people. For 'efficient' government, each citizen can be numbered with a universal identifier and all personal records controlled and centralised by the state. This would make administration of all aspects of government much simpler and efficient, provided that the personal records accurately represent reality. Many feel that this dehumanises them. It would, of course, be a boon to any form of totalitarian government wishing to control and manipulate its citizens. People's lives could be seriously affected by incorrect data kept in computer databases.

When the student leaves full time study and training to enter the work force, the chances are that he or she will immediately be introduced to the effect of computer technology. While in the past the computer was likely to be encountered only in the office environment, and even then only 'second hand' through the use of computer print-outs to obtain information and the use of coding forms to enter data, all this is now rapidly changing. In some organsiations the time has already arrived when it is just as usual to have a computer screen on the work desk, as it is to have a telephone.

The new recruit communicates with other staff – both in the same building and in different cities or countries – using electronic mail. Facilities now available allow many to choose between working at home or in the office, depending upon their own domestic, geographical and physical circumstances.

While the possible 'dehumanising' of this type of working situation is a matter for some concern, the ability to choose the environment which best suits the individual should prevent this situation from seriously affecting the quality of life.

Managers now find that a vast amount of information is available, literally at their fingertips. No longer the tedious searching through vast stacks of paper files or the endless mechanical adding of long columns of figures. Business decisions of all types are made with the aid of computer models, instantly able to compute the effects of possible changes in financial circumstances or rates of sales.

Those involved in the typing of documents find themselves operating powerful computer systems. They have a new challenge in applying creativity to their jobs now that the drudgery of endless retypes, through error or a change of mind on the part of the author, has disappeared.

Engineers once crouched over their drawing boards, slide rule in hand, now sit before a computer screen and use a 'mouse' or 'joystick' to design buildings, roads, machines – virtually anything. As in the cases described above, the tedium is removed and the engineer can devote all available time to creative design work. A myriad of specially developed programs can be accessed through computer terminals to check stresses on beams or diameters of pipes or steam pressures in mere moments, saving weeks of manual calculations.

Sales staff on their rounds are able to collect orders using small handheld computers and, at the end of the day, quickly and accurately communicate these directly to the warehouse for speedy delivery. The system cuts down the paper work and gives the customer quicker delivery with fewer errors.

Moving into the factories we find the school leaver working with a vast array of computer systems in the production control area, monitoring the progress of manufactured goods and ensuring a steady supply of raw materials and labour to produce the end product. On the production line computer controlled machine tools drill, cut, press, weld, bend and even paint the finished product. Our new recruits soon find themselves programming and operating many of these very sophisticated systems. In the transport industry the worker is aided by the computer in scheduling deliveries, maintaining equipment and, in the case of shipping and aircraft, aiding navigation.

The application of computers provides its own career opportunity. Already New Zealand is gaining recognition as a potential supplier of software in the international market. New Zealand's experience has been with more limited computing resources than elsewhere, so we have learned to make better use of the technology. We have had to become more skilled at integrating separate systems of computer application. These skills have become a very marketable product, to the extent that a number of software houses have sprung up around the country providing work opportunities for a large number of people, many of whom are involved in developing systems which are in demand overseas.

Young people are becoming involved in the technical side of the computer industry as engineers and in the service area. In these jobs they find themselves working closely with technology, not just in repair situations, but also using computers as diagnostic tools.

While one would expect those working in agriculture, horticulture and in fishing to be out of doors growing and harvesting nature's output, there is a place for computers to help in primary industry. In the modern world primary industry must take a professional, business-like approach. This means that the computer will be there as one of the tools used by the industry. Farmers, endeavouring to expand or develop and requiring resources, will use a computer to formulate the funding and execution of their plans. The computer will be used to monitor output of such things as grass growth for grazing animals and hence enable better utilisation of the resource. Each animal will be tagged in such a way that each beast's progress will be monitored and recorded. Stock weights will be taken more frequently with the computer system recording the data automatically. Culling of stock will be efficiently guided by the computer.

The computer will be used for the selection of plants and animals from which agricultural products are derived. In some cases the computer will take over work such as adjusting irrigation and growing climates by remote control. The computer will be able to give early warning of damaging meteorological situations such as frosts and even initiate countermeasures.

The computer will provide farmers with the best market information available. This means that the economic signals that are so important to the efficient allocation of resources in a free market can come into play. The farmer will be spending more time indoors managing the farm with the help of the computer. Farming will become an unsentimental sophisticated business activity, managed efficiently with the help of computer software.

Pressures on secondary industry from adverse economic changes have led industry leaders to search for ways of shielding themselves from these economic fluctuations. Automation, in the form of computer technology, has been fastened upon as a means by which escalating costs of labour may be held and the quality of the product improved, with the result that fewer rejects will provide an improvement in the base cost of the product itself. The drive for increased productivity has led to the introduction of computer technology throughout the whole range of manufacturing.

Production control systems explore the componentry of the individual items being produced, compare the requirements to current inventory, automatically order required materials and finally construct the production schedule. Problems with equipment and slippages are entered into the system as they are encountered. The system regroups the resources, issues instructions for reordering of materials or reallocation of equipment and produces an amended production schedule.

The availability of such a facility has a fundamental effect on the working environment of the organisation. Staff handling the production planning functions are able to use their creativity in using the computer as a tool, to reinforce their decision-making abilities and remove much of the stress arising from the necessity of processing a large volume of information and making many important decisions in a very short time.

The system also reduces the time during which production is held up, relieving stressful situations from the point of view of the workers on the production line, as well as keeping down the end cost of the product to the user.

Further down the production line we find the use of machine tools in almost every area. These machines range from simple computer-operated lathes and drills, to complex fabrication, welding and assembly tasks. The programming of this type of equipment is carried out in a number of ways. In some cases the machine supervisor uses a computer language to explain the requirements to the machine. In the newer systems, where the activity requires physical movement rather than complex and highly accurate machining (e.g. painting), the computer is able to learn the task by following the movements of the operator. This effectively puts the operator into the role of trainer rather than being limited to carrying out a monotonous recurring task.

Control of the quality of the item produced is often handled by a plethora of computerised measuring, testing, and weighing machines, reducing the incidence of dangerous and defective units delivered to the consuming public. Apart from the reduction in risk to the public, the improvement in overall quality reduces the stress factor to the consumer.

Finally packaging and distribution are often aided by computer systems, ensuring that the product gets rapidly to the consumer in good condition.

In the effort to shorten the time lag between initial conception of a product idea and the direct marketing of the finished item, manufacturers are turning to computer-aided design. This technique involves the use of a sophisticated computer program to simulate the finished product. Designs may be instantly altered and drawings produced in a fraction of the time needed under a purely manual system. Benefits to the consumer include a much wider selection of goods and a higher level of safety in the finished article.

The vast increase in consumer goods, with its attendant expansion of manufacturing resources, is resulting in an equivalent expansion within the service industries. Under this category may also be considered the transport area as it strives to distribute goods and move more people around the country.

Looking firstly at maintainance and support areas we find that many companies are using computerised systems to provide better response to customer calls for service, by scheduling calls and tracking locations of support vehicles. Similarly there are now databases of technical product information which may be searched using the symptoms of the problems encountered. Computerised parts systems enable rapid access to stock held in any part of the country and even outside New Zealand. Databases of installed equipment enable rapid recall of equipment found to be defective in manufacture. The aim in all of these cases is an improvement in service to the customer and an increase in safety standards.

The computer industry itself, of course, is providing employment opportunities in the rapidly expanding world of computer support. It is impossible to predict the magnitude of this particular area of the service industry as the sophistication, reliability and reduction in size and cost of computer componentry is gradually leading to the situation of the 'disposable computer'. How do we see these factors affecting the quality of life in this country? Firstly, the consumer having purchased more aids to assist with work and leisure, is assured of rapid service and response to calls. This knowledge, that support is at hand, reduced the frustrations caused by breakdowns when they occur.

That part of the transport industry involved in moving people around the world has made effective and spectacular use of computer technology. Travellers sit back relaxed in their aircraft seat secure in the knowledge that they are protected by a network of computers constantly monitoring the progress and status of the aircraft. Their tickets and seats have been reserved well ahead of time and any special requirements for their comfort noted and attended to. On-board computers handle navigation using satellite locational data. These, combined with computerised radar systems checking ahead for bad weather conditions, assist the pilot to make appropriate course corrections. The flight engineer is constantly fed information by another set of on-board computers monitoring fuel-flow, temperature, airspeed, icing conditions, etc, ensuring that any slight malfunction will result in immediate detection and corrective action. On the ground computerised radar and locational systems follow the aircraft's every movement, ensuring that the many thousands of aircraft moving around the world each day maintain safe distances from each other.

In order to ensure their customers' comfort the airline uses many sophisticated computer systems to schedule flights, ensure supplies of food and drink, maintain the aircraft wherever it goes and even to train its staff. A large proportion of pilot training is carried out by flight simulators, incredibly complex and sophisticated computer systems which realistically produce, on the ground, every possible situation which might be encountered in the air. In short the airline passenger is probably the most computer-protected person in the world and the record is a good one. But here too the technology must be treated with care, as instanced by the ill-fated flight which crashed into Mt Erebus, at least in part due to over reliance on the on-board computer navigation system.

Computers are making their presence felt in the area of leisure activities. Even the smallest towns have a video entertainment centre, where a dazzling array of computer games test the ingenuity and dexterity of the nation's young (and not so young). This fascination for competing with the computer is now being carried over into the home, where a great variety of home computers are being connected to the family television set and the battle with pacman and the space invaders joined. On a more serious and challenging level the computer can provide chess enthusiasts with a more competitive partner than they might ever encounter in real life.

For many years now computers have been used for keeping track of sporting results, records, participants etc. This type of leisure use of the computer is seen at its best in the computer-controlled complexities of the Olympic Games. The advent of teletext and videotex enables people to obtain information on the host of leisure-time activities available and even to reserve tickets from their living room. The computerised local public library will provide the facility for the rapid access to books from libraries throughout the country. Computers are undoubtedly changing and extending the lifestyle of the human race. The difference between this and previous occasions where new innovations have had an impact on our society, is the speed with which it is all taking place.

Comment by the Editor

The above contribution does, I believe, present a reasonably balanced picture of the impact electronic computer technology is having, and will have, on our community. It does not attempt to look too far into the future even if that were possible.

It is not hard to see that significant changes are going to be made in our lifestyle; some good, some the opposite. While the advance of computer technology in the workplace is beginning to have an overall effect on the number of jobs available in certain areas, especially offices and factories, the total effect is in part offset by the number of jobs created from within the computer industry itself. It is not that, at the moment, jobs are necessarily being lost but that new positions are not keeping pace with the increased amount of work being generated. In the long term it is likely, bearing in mind that the labour force is increasing, that the result will be an overall reduction in the ratio of jobs available to job seekers. Whichever way it goes, there can be little doubt that the increasing use of computers will mean a substantial decrease in the amount of time that the average person will spend engaged in the activity we now describe as 'work'. One of the results could be an earlier retiring age but almost certainly the net effect will be that leisure activities will assume a far greater importance than hitherto.

Many people are concerned that the replacement of workers by machines will cause mass unemployment and the fact that there is already unemployment in the western world is not reassuring. The question they are asking is, 'If most productive work is done by computerised machines, how will people gain an income with which to buy the goods the machines produce?' Others fear that nuclear war could be triggered by too great a reliance on computer systems.

As far as the first point is concerned some of the answer must lie in changing our concept of what constitutes work. Many of our social services which rely heavily on voluntary labour could be improved by an increased, and paid, labour force. Again, the displaced 'production' workers could, given the opportunity, be found to be talented artists or skilled entertainers and be suitably rewarded for developing their talents. In the ultimate it could be that means other than work as we know it today, will need to be found to distribute the wealth of a nation.

Both here and in ensuring that we are not led into a nuclear holocaust or a world dominated by 'Big Brother', the solution will be found in maintaining our control of the technology. Among the favourite phrases to be found in old copy books drawn up by our Victorian forebears to improve both the calligraphy and wisdom of the young is one stating, 'Fire is a good servant but a bad master'. How much more so does this apply to the power of the computer? Here is a great challenge and it is surely inconceivable that we shall not successfully meet it, even if the pressure is on and the pace faster than anything we have ever experienced before.

CHAPTER TEN

A NEW INDUSTRY FOR NEW ZEALAND

M.S. Kaiser

Martin Kaiser is an industrial scientist working for the Department of Scientific and Industrial Research. He was educated in the United Kingdom gaining a B.Sc. (Hons) in Physics at the London University in 1961. He is a Chartered Electrical Engineer with wide ranging experience in industry. He came to New Zealand in 1970 and set up the Computer Advisory Service of the Physics and Engineering Laboratory of the DSIR. More recently he has been surveying the use of technology by industry. He is a member of the Technical Marketing Unit of P.E.L.

Information Technology (IT) is one of the world's fastest growing and important industry sectors. Electronics, telecommunications, computers and software in particular are key elements in Information Technology. Figures commonly quoted range from thirty to fifty percent growth per year in many parts of the industry.

There are at least two aspects of this growth of IT. One is the new opportunities and job creation in the IT industry itself, the number of people providing hardware, software and services will grow. The second, more important, aspect is the productivity increase and other advantages to industry and commerce in general brought about by using new IT techniques. Examples are the productivity gains in a legal office through using word processors, the speed of response in banking and money markets through using on-line international data links, and the efficiencies of using computer design and control in manufacturing processes. The productivity improvements possible range widely but the norm seems to be at least one hundred percent.

The importance of IT can thus be seen, both as an industry itself and as a productivity boosting technique for other industries and commerce of all types. The question is, how can New Zealand take advantage of these opportunities?

If we examine the trends of the last five to ten years we find them taking many new and unpredictable directions. One disturbing trend is the increasing pace of change. In the past people have had a generation or so to absorb big changes in technology and the consequent social changes. Now quite marked changes occur over a two-to-three-year span. Examples are the advent of the pocket calculator and cash register for school and retail use, the credit card and money dispensers, and the dramatic use of the microcomputer in many applications. Adaptation to change is less rapid. It takes time to develop an infrastructure of suppliers, servicemen, training facilities, consultants and technical information.

To survive, New Zealand industry and business has to be able to absorb the new IT technologies and use them to advantage, at least as fast as its competitors. In general, New Zealanders are good at rising to this sort of challenge. However, it is often a result of individual efforts and the average company lags well behind the innovators. We are individualists and not so good at collective, strategic planning.

As regards the new opportunities for marketing products of the IT industry itself, we have to make quicker progress and work together more readily. Because the IT industry is new and dynamic it can change more rapidly. It is generally recognised that New Zealand cannot expect to make breakthroughs in design or manufacture of large numbers of high technology electronics products such as television sets, video recorders, or microcomputers, nor in the design and manufacture of mass produced silicon chips. Some countries and multinational companies are leaders in high-tech, aerospace and electronics applications. They pour so much money into research and development, production facilities, and marketing that we cannot compete in these fields. However, we can do pioneering work and achieve worthwhile production runs through winning markets in specialised areas – the so-called 'niche' philosophy.

On the hardware side, we have produced and sold overseas specialised microcomputer-based equipment; petrol pumps, electric fences, and motor speed controls. With the DSIR Physics and Engineering Laboratory's new Silicon Facility, custom chips can be designed and manufactured here in New Zealand, thus shortening the development time and getting to short-lived markets quickly. The product design will also be less vulnerable to piracy.

However, I believe that it is the software development and services side of IT that New Zealand can really make into a new industry. For example, software development in selected areas; or consultancies based on practical experience with smaller industries (which are now getting into computers world-wide). Also in other service industries such as information storage and processing, and the recently highlighted 'learning' industry.

More of these opportunities later. Let us now consider the existing marketplace and our strengths and weaknesses.

Firstly, we must look historically at the role of governments in relation to industrial development in New Zealand. Protective barriers were put up to give local industry a start. These barriers were often quantitative licence controls but we are now changing more to tariff barriers (e.g., incoming goods have to pay a customs duty of a percentage of their cost). The widespread reliance on protection by licence has left industry generally with an attitude of charging whatever it costs them to produce items plus a profit margin. The local market has been shared out; there has been a lack of aggressive marketing and competition in many (though not all) industries. Government has been looked to for protection against competition from other countries, and for subsidies to help exports compete. A 1980 DSIR survey of the manufacturing industry showed many companies even look to government for overseas detailed marketing information! Government incentives and subsidies have been broadly targeted, so 'poor' exporters as well as 'good' exporters, for instance, have been helped with subsidies. Government officials are reluctant to try to 'pick winners' and select industries to encourage. New Zealand exporters have not in general worked closely with each other, or with government, except for some primary sector Producer Boards.

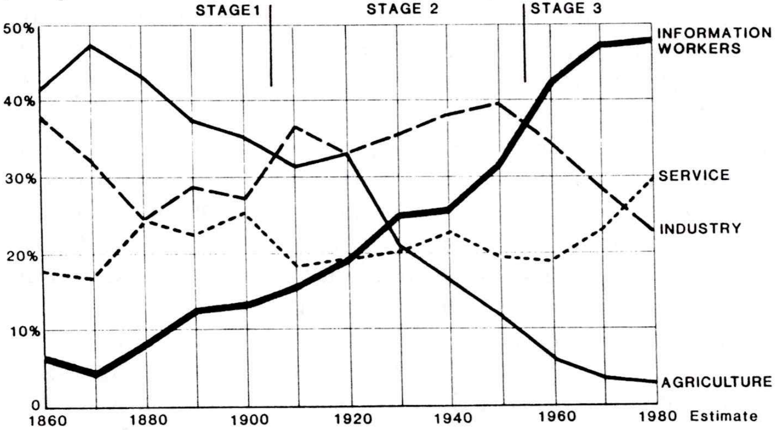
This has left us with a wide range of organisations in each industry – some good performers, but many not really under pressure until recently to improve productivity in order to survive. Few industrial organisations have, until the last three to five years, had experience competing in overseas markets.

The government's role in providing background assistance and a 'good' environment must not be forgotten. The spending on education at primary, secondary and tertiary levels has produced a well-educated workforce by world standards that has a relatively low wage structure. A relatively high percentage of our students go on to polytechnics and universities. Our public sector infrastructure is well developed, our technical services, such as the Post Office telecommunications, the broadcasting services, the Ministry of Agriculture and Fisheries, and the DSIR, are good for our size of country.

It is difficult to generalise about the private sector in New Zealand having, as it does so many industries and range of size of companies. The DSIR survey of the New Zealand manufacturing industry in 1980 showed we had less large companies as a percentage of our total than in many other countries. The study also showed we have innovative companies, many small in size, who succeed in exporting their products and services against international competition. In world trade terms we are small, with only a fraction of one percent of world trade. Even our large primary industries are small in terms of total world production and trade. These primary processing industries, meat, wool, dairy, etc, have learned to harness the efforts of individual farmers, through co-operatives and co-ordinated overseas marketing, to take more than a proportional slice of the world external trade in their products. The manufacturing sector is growing rapidly as an earner of overseas exchange, but the twenty-five percent of total exports claimed in recent years includes some further processing of primary produce such as timber, pulp, food, carpets, etc.

The service sector in many countries is growing while the agricultural and manufacturing sectors are falling (see Figure 10.1). The information handling and processing sector is the largest employment sector. A recent OECD report shows that about forty percent of the 'economically active' population (i.e., the work force) is engaged in information occupations in OECD member nations. New Zealand, by the way, is well up in the field in this regard.

Fig. 10.1 FOUR SECTOR AGGREGATION OF THE U.S. WORK FORCE BY PERCENT 1860 – 1960
(Using median estimates of information workers.)



SOURCE: Porat. "The Information Economy" U.S. Dept of Commerce based on Census Bureau and Bureau of Labor Statistics

The message is clear. Growth of employment is in the service and information handling sectors. Barry Jones (now the Australian Minister of Science) makes this clear in his book *Sleepers Wake* 1982. The other sectors use productivity raising technologies and need less people to sustain food production or consumer/industry material needs. There is some evidence from Figure 10.1 that the employment percentage in the information handling sector has peaked. The use of data processing equipment like computers, is reducing the number of direct employees, as has happened in agriculture and industry. The demand for software to drive these ubiquitous computers turns towards more productive, sophisticated, user-friendly designs. As the service sector continues to grow, the demand for software to provide specialised services will grow too.

Development of software is an activity where New Zealand can compete in world markets and also assist its own business and industry sector to improve its productivity and competitiveness. Software is very much a growth industry.

The local market for New Zealand software is, however, small even though our national use of computers is relatively high by world standards. We have clusters of population separated quite markedly by distance. Thus marketing, servicing and support of a product is expensive and diffuse. Any 'vertical' marketing (to one industry or activity, e.g., pharmacies, travel agents) means covering several centres to achieve a worthwhile number of participants. In spite of this geographical separation, the local market does have the advantage of a common set of laws and ways of doing business. It does not have separate states or much difference in local body regulations. Thus a package developed for an Auckland organisation can easily be used in other centres.

However, there is an independent streak in most New Zealanders. They like to develop their own way of doing things and even to write their own software. They also tend to be wary of software (and other items) developed in New Zealand and often look to overseas suppliers. This is particularly noticeable with those companies who subscribe to overseas journals and whose senior staff make frequent overseas visits. Recent local developments of New Zealand-written software and a rise in professionalism and quality might not have been noticed by some organisations purchasing software. This characteristic of preferring NIH (not invented here) products is not confined to software purchasers! The local industry must counter these attitudes by active directed marketing.

Several New Zealand companies have put together good suites of software packages and, with good marketing and support, have won a reasonable share of the New Zealand software market in accounting/inventory applications on microcomputers. Other success areas are locally written production orientated packages, and remote on-line transaction processing and communications.

Looking overseas, we find that New Zealand is not well known for its manufactured or technology products. A few breakthroughs have been made in the world scene, mainly in specific narrow markets. The present higher profile of New Zealand products, from kiwifruit to electronic petrol pumps to software generator tools, will do a lot to help marketing products, provided the product quality and continuing supply and support can be maintained. A few shoddy goods, marketed by amateurs and not followed up, can undo all the good work.

We have strengths in certain markets and in some types of industry. We are innovative and flexible and have an educated workforce. Our systems and legislation are similar to the English model used in many countries, and we do speak English. But we must be aware of the weaknesses, the small scale of our society, our cultural narrowness (compared with countries with varied immigrants), and our distance from the marketplace.

Many of the general features discussed above also apply to software development and exports. But in the computer and software fields many other countries are ahead of us, both in the breadth of their applications and the attitudes of their business and industrial users.

An early sample from a survey I conducted for the DSIR (in August 1984) revealed some interesting perceptions of the strengths of the New Zealand software industry, by people in the industry. The major strength was seen as New Zealand's comparatively low wage costs for software development staff and the flexibility and skill of staff. Other factors featuring high on the list were our good quality software and design skills, our efficient use of computer hardware and success in the marketplace. Factors expected to encourage future growth were, reduction of sales tax, government incentives and improving marketing skills. Better availability of capital was mentioned, as was improving staff training and reducing hardware costs. One factor not mentioned by many, but which I feel is significant, is the closeness of the user and software developer. Both physically and organisationally they are closer than in other more populous and structured countries. This closeness can speed up development and improve 'user friendliness' in the software.

Whether these perceived strengths are real in competitive terms, compared with other countries, can only be tested in the marketplace. They seem to agree with comments of overseas visitors coming here. A marketing strategy builds on the strengths of a product or service, watches for shifts in the competition or marketplace, and also plans to reduce the effect of weaknesses. But above all, the 'pull' of the marketplace needs to be assessed and 'niches' identified.

The same survey highlighted the weaknesses of the New Zealand software industry. Some of these are self-evident, e.g., distance from the main export markets, lack of infrastructure due to small home market, etc. Others are more subtle, such as the small size of individual software companies and lack of co-operative efforts. According to the survey figures the software staff of the 200 organisations writing software for sale was only about 800 people.

Other survey results showed most people thought that our poor overseas marketing was the biggest weakness, followed by a lack of confidence (and of credibility) and inexperience. Poor management skills and high overall costs were also mentioned. Feedback from the successful and unsuccessful marketing efforts for New Zealand software overseas is sadly lacking. One or two companies have made their experiences known to others in the industry. A New Zealand Computer Society Seminar on Exporting of Software was held in conjunction with the 1983 Conference. It was of some value, and the first in New Zealand. We need more. More people must become involved in sharing their experiences, collectively working out a New Zealand software marketing strategy and then taking action.

Most New Zealand companies do not use people based overseas to market their software, relying on casual contacts and occasional visits by New Zealand-based staff. Spending on marketing averages perhaps four percent of sales in New Zealand and about five percent of sales overseas; excluding a few spending a lot on market development. These figures appear to be relatively low in an industry where several demonstrations may be necessary to clinch a sale and where there are so many apparently similar products on the market. Market development costs can, at present (1984), be claimed as a tax credit, and market development grants are available.

After poor marketing skills the major factor hindering growth of the New Zealand software industry is the lack of experienced staff. Our training organisations produce some good people, but not enough have practical business experience or appropriate computer language skills. Many leave the software sector or go overseas rather than work in New Zealand. The reluctance of companies to train staff for themselves also showed up in the survey. They relied on getting trained staff from elsewhere, often other New Zealand companies. Also, the average time spent on training for software writers in employment was only one week per year which, in view of the rapid changes in the industry, seems very low.

Another weakness frequently mentioned is the high cost of capital. It seems software is not yet considered a worthwhile or 'secure' product for investment. There are several factors at play here. Assets in the form of developed software are often not recognised by the software companies themselves, let alone by the financial community! A surprisingly large amount of time has to be spent in writing good software and thus development costs appear to be disproportionately high. It has never been easy to persuade financiers to invest in brain power. Also, the high occurrence of software piracy and short life of the product may influence the financiers' view on the chance of getting a good return on their investment.

In spite of the weaknesses, the industry has had some notable achievements, particularly over the last few years. New

Zealand-written software has been sold for many years; some of the organisations covered in my DSIR survey had sold New Zealand-written software for ten years or more. Half the companies selling New Zealand-written software had been selling it for three years or less. Three-quarters had been selling it for less than five years. On the whole, selling local software is a very new industry for New Zealand. Local sales of New Zealand-written software were about $15 million in 1983 according to my DSIR survey. Over 200 organisations are writing software for sale. Exports are harder to monitor, but early examples include Progeni (school timetables in 1972), IDAPS (insurance packages – late 1970s), ACP and Intec (accounting packages – late 1970s), Mana Systems (operating systems – 1980), and Progeni (software generators – 1980). Exports of software in 1983 were between $5 million and $7 million according to my DSIR survey. Forecasts for 1984 and 1985 indicate that at least fifty percent growth is expected. About fifty organisations are currently exporting New Zealand-written software.

Many New Zealand software writers are working overseas and seem to have little problem getting jobs. Indeed, many organisations recruit New Zealand-trained people. A few New Zealand software companies have established branches overseas in America and Australia. Some Australian bureaux and software companies have been taken over by New Zealand companies.

With the marketing of the LINC New Zealand-developed system through the multinational company, Burroughs Ltd, New Zealand software has won world-wide sales. Even at a price of about US$40,000 over 1000 sales had been made in under two years. Some purchasers know it came from New Zealand but not enough are aware of this fact. Now Adata Software have designed an advanced system for software development, EXSYS, and Data-General Ltd are assisting in marketing it world-wide. Other multinationals like Digital Equipment Ltd, with their Technology Village software development facility, and IBM with their local software procurement programme, are actively seeking New Zealand-written software for marketing world-wide.

One of the questions asked in the 1984 DSIR survey of the New Zealand software industry was 'Who do you think are the leading New Zealand-based software development companies?' The clear leader here was Progeni Systems with over half of respondents naming them in the top three. Second came Interactive Applications Ltd, third were Burroughs/LINC, and fourth CBL/Datacom. Other companies named were Computer Consultants, Adata, IDAPS and the Paxus Group (includes IAL and IDAPS). The research did not differentiate whether the companies did in fact produce innovative software or were just good at marketing their product. The top named companies were also the leading exporters of New Zealand-written software. They were also quite large by New Zealand standards.

The industry is maturing rapidly. Over the past few years there has been a definite trend towards amalgamations and the formation of groups of companies. The New Zealand Insurance Computer Group (NZ South British/Paxus/IDAPS) has acquired several important New Zealand and Australian computer and software companies and now has over 600 employees. Andas (Armstrong & Springhall/Powercorp) has also emerged as a big group of computer companies, including software development specialists. This trend, with the other moves by New Zealand software companies to market through multinationals, has given the New Zealand software companies access to finance and, more importantly, to mature marketing skills and overseas representation.

Another interesting development has been the trend for multinationals to release new hardware in New Zealand earlier than before. The Apple McIntosh, for example, was available in New Zealand only a few months after its release in the United States. This enables our software people to develop software for the new types of computer much earlier than previously. This, coupled with the fact that it does not take much capital to set up a software development company, means that New Zealand companies can be up with the world leaders in software much more easily than in most other industries. We do not make enough of this advantage!

The Industries Development Commission study of the New Zealand electronics industry has helped raise the profile of professional electronics and software. Some government funding is now targeted into electronics and software. Other Research and Development funding recognises the importance of electronics, computers and software. This gives the industry some credibility and must help attract private investment and venture capital. There is also more awareness of 'hi-tech' products in the community and industry as microchip-based products and machinery become more common. We now have some microcomputers in most secondary schools.

There has been a realisation that New Zealand has got good facilities, well-educated and trained people who can quickly be productive in these new industries. Responses to the survey showed that about forty percent of staff writing software for sale had a degree level qualification! With our multicultural society and good relations with many less well-developed countries we have a unique position in developing consultancies and a 'learning industry'. We can get close to people in many countries yet we have the advantage of English as a language – the most universal language. The harnessing of computer, video and storage technologies with our well-developed 'remote' teaching skills (e.g., correspondence schools and technical institutes) could be the start of a new 'learning' industry.

The trade associations and societies connected with computing have become more professional. Some have appointed paid executives and undertake educational and promotional work in addition to the narrow 'self interest' activities of earlier years. Their promotion of ethics, standards and professional liability is helping to turn computing into a recognised profession, and to improve the public image of staff and companies. Organising training and professional development seminars is helping to raise the level of knowledge of existing practitioners. There has also been more involvement with international computer organisations and conferences. The importance of the Australia/Asia/Pacific computer and software industries has been realised and more efforts are now being made to make contacts here. Showing one's product at trade fairs and exhibitions has become common now in New Zealand, but not yet frequent enough overseas. Co-operative efforts here, involving the Department of Trade and Industry, could be of great importance to New Zealand software exports. The various associations like the NZ Computing Services Association (CSA), the Computer & Office Products Industry Federation (COPIF), and National Electronics Development Association (NEDA), together with the NZ Computer Society (individual membership rather than organisations) must be careful not to overlap or be too fragmented. Most now have observer status at each other's meetings, which is an excellent start to the co-ordination of their efforts on behalf of the industry.

But while we have undoubtedly been developing, the rest of the world has not exactly been standing still either. The development of computer and software industries in Australia has been noticeable in the last few years. Government influence has been significant and there has been specific assistance in some cases. The 'hi-tech' theme has been promoted there, particularly since the election of the Australian Labour Government in 1983. However, there does seem to have been some fragmentation and duplication in the Australian software scene between representative organisations. They also have a problem of geographical separation of the main cities and the rivalries of different State activities.

The recent formation of the Asean-Oceanian Computer Industry Organisation is a significant step in international co-operation. Singapore has declared its intention of becoming the software centre of the Asia-Pacific region. In its usual determined style the Singapore Government has initiated some impressive projects. New Zealand must become involved in all these areas. So far most participation appears to have come from the personal initiative of a few people rather than planned action by the government and industry.

Further afield we find the computer and Information

Technology industries growing very rapidly. Every couple of years some major change occurs which influences the direction of the whole industry. Some recent significant changes have been the advent of 16 and 32 bit processors, high quality graphics, the 'user friendly' 'user driven' software and, of course, the dramatic rise in the use of stand-alone microcomputers as PCs (personal computers).

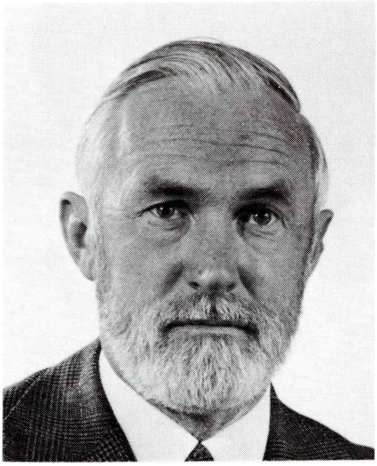
A more strategic stage has now been reached, with several countries taking significant actions to move their computer industries towards stated goals. The influence of the countries who lead the world in Information Technology has been realised. The Japanese have moved into computers relatively slowly in the world scene, but now with their 'fifth generation' project have set their sights on leading the world. The goals include man-machine interfaces, expert systems and artificial intelligence, VLSI circuit advances and software development. The project is a partnership of government and industry with massive funding.

Other countries, who have in the past relied more on individual company innovations and progress by competition, have seen the need to co-ordinate their industries to avoid duplication and to match the expected progress of the Japanese. The United Kingdom Government took a deliberate step in IT promotion with public awareness programmes, industry microelectronics subsidy schemes etc. The success of these IT awareness programmes can be seen in the change of attitude of the public, industry and business. It was a classic case of marketing concepts, leading to a demand for the product. The United Kingdom 'Alvey Report' follows this up with a programme of funding and organisation in the 'fifth generation' direction. The United Kingdom Government will be spending hundreds of millions of pounds on IT over the next five years.

The EEC nations have an 'ESPRIT' plan for a European 'fifth generation' project. France has also set up some ambitious independent schemes for its computer and software industry.

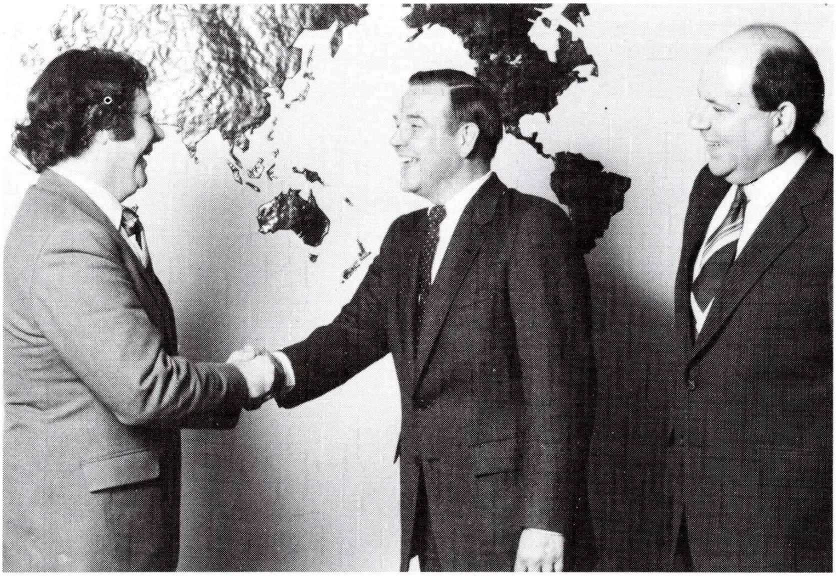
In America, which still dominates the world computer

Mr D. I. Brown, MNZCS. President of the New Zealand Computer Society 1977-78.

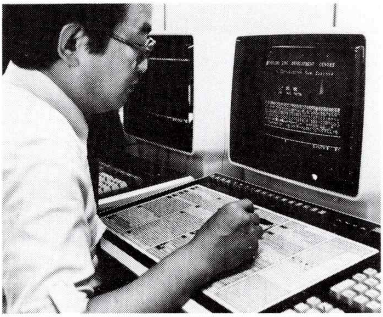


Mr B. A. M. Moon, FNZCS. President of the New Zealand Computer Society 1978-79.

Mr B. A. Wickes, President of the New Zealand Computer Society 1979-80.



Gil Simpson (left) and Peter Hoskins (right), two Christchurch software developers, with Burroughs Corporation Vice-President Robert Holmes, who had arrived in New Zealand to announce that Burroughs had accepted their Logic and Information Network Compiler (LINC) for distribution around the world.



A representative of Burroughs, Japan, at the Linc Development Centre in Christchurch, translates LINC into Japanese.

1984 and another Christchurch software developer moves into the international market. Adata of Christchurch produces the Exsys operating system taken up by Data General for marketing around the world. In the photograph Adata founder Rodger Nixon witnesses the first New Zealand sale. From left, Rodger Nixon, Trevor Pope, the secretary of the Farmers Cooperative Organisation Society, and Don Smith of Data General.

scene, some of the leading companies have seen the urgent need for co-operation to meet the threat of other countries' national plans. Companies like Digital Equipment, Motorola and National Semiconductor are now working out joint research programmes in the MCC (Microelectronics and Computer Technology Corporation) launched in 1983.

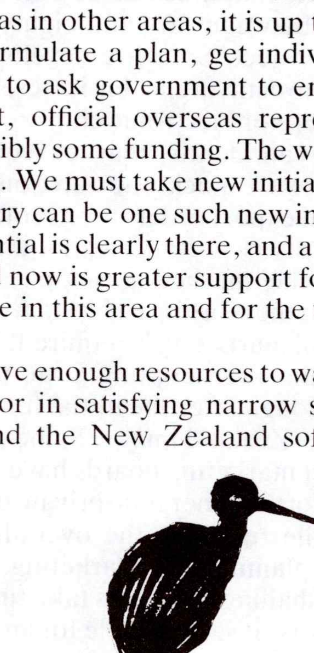
The strategic nature of the planning and the setting of targets by national bodies, indicate the computer and software industries are maturing. It could now be the right time to plan New Zealand's place in this world of IT, with its importance to all forms of world trade. In the past, New Zealand has been at a disadvantage in the computer industry, because of the large amount of money needed to make advances in computer hardware and particularly in silicon chip design and manufacture. We have been users of the new technologies rather than developers. However, now that software has become so much more important, New Zealand's role can become that much more significant. Software can now amount to between fifty and eighty percent of the cost of a computer project. Software development does not need such a large investment in basic research or capital equipment as hardware or electronic chips.

Providing that we can identify market requirements, provide good quality software quickly and give on-going support, New Zealand can win export orders for its software. Distance from overseas markets is not an insurmountable problem. The technique of 'niche' marketing is applicable rather than attempting to take on the world on a broad front. In addition, some co-ordination of marketing is required. Too often, individuals and companies are adopting a 'go it alone' policy. They find the going tough after the initial few sales and crash out, spoiling the New Zealand image. Some of the New Zealand primary product marketing boards have done a good job co-ordinating the efforts of energetic private entrepreneurs in their industries, while retaining the overall benefit for the industry. Strategic planning of marketing, the setting of objectives, and marshalling resources take time and goodwill among the participants. It seems a role for an industry-led co-operative with some government support and backing. It needs the New Zealand software industry to come up with some specific proposals, and to get their member companies' commitments to such a proposal before it can go further.

The respondents to my 1984 DSIR survey of the New Zealand software industry gave support to this concept. Improving marketing skills, co-operation and action by the trade associations featured in both home and overseas markets. But in exports the expectation was that government should also provide incentives and market development assistance. In answer to the wider question 'Who should take up these ideas to improve the industry?' both trade associations and the government were listed. However, there were some replies which said 'no' to government involvement! Those who named other people or organisations predominantly gave as examples existing New Zealand export successes such as Producer Boards and individual industry leaders. Hardly anyone said use multinationals or overseas agents.

So it seems, as in other areas, it is up to the industry to get together, to formulate a plan, get individual company support, and then to ask government to endorse the plan with formal support, official overseas representation and presence, and possibly some funding. The world is changing, society is changing. We must take new initiatives for export. The software industry can be one such new industry for New Zealand. The potential is clearly there, and a start has been made. What is needed now is greater support for those few who are at present active in this area and for the various trade groups and societies.

We do not have enough resources to waste them in overlapping activities or in satisfying narrow sector interests. We must get behind the New Zealand software industry and make it grow.



ANNEX

A FEW OF THE FIRST

As part of the Computer Society's Silver Jubilee activities the Oral History Archive team led by Hugo Manson and Judy Fyfe was commissioned to record the memories of some of those associated with the introduction of computers into New Zealand. The result is over forty tapes covering a dozen interviews, all carefully indexed and now housed in the Turnbull Library for safe keeping. It did seem a pity to stop there, for while the material will be of use mainly to historians, there is also the human side. Hugo Manson and Judy Fyfe, in their report, noted:

> The interviewees in this project are a remarkable group of people who were in the forefront of a dramatic new development with equally dramatic implications in New Zealand life. They did not carry out their pioneering work by accident. A number of factors led to their involvement. They were all people of high intelligence and skills, with the ability to recognise radically alternative methods and approaches in their particular fields. It would seem that they were prepared to stay with the new technology during the difficult early days, and had the strength of conviction to persuade and demonstrate to those who could back its development, that this was essential if New Zealand was to keep up with the rest of the world.

So we gave the tapes to Anne Else, a Wellington journalist, and asked her to let us have her impressions of this sample of the new breed of pioneers. Here then are her comments.

GRAEME BARNARD

Graeme Barnard has had a varied career in computers. He was with IBM, first as a sales representative and later as a systems engineer, at a key period, when they were implementing some of the earliest government computer installations. Since 1964 he has been involved with private computer consultancies and companies; today he is head of On-Line Computer Systems Ltd.

He was born in Inglewood, Taranaki, in 1934. His father spent his whole working life in banking; his mother, an excellent pianist, was a school teacher. Graeme grew up in a large house opposite the Moa Dairy Company. He recalls with gratitude both his primary headmaster, Ted Seville, 'a brilliant teacher of the arts', who encouraged in Graeme his great love of music; and L.J. Wilde, first principal of Feilding Agricultural High School: 'Such was his standing in New Zealand education that when he retired, he was made Chancellor of the University of New Zealand.' The school ran two farms, and he helped on them in the holidays: 'I loved that too . . . I'm no farmer, but I can walk on to any farm in New Zealand and know what I'm talking about.'

He remembers also the early days of radio, and 'looking inside the back to see if I could see that man talking to me'. In his teens, his hobby was radio building; buying valves, at ten shillings and sixpence apiece, took 'round about a whole term's savings'.

At university he took science, but thinks now that he might have been better off doing engineering; 'Today I might have taken a Bachelor of Technology degree.'

He was offered a government job, but, 'the idea of being able to predict one's future just didn't really have too much appeal. Quite by chance, I got caught up in a little Agriculture Department project which was very important to my future.' He took six months to design and build a machine which did a day's work in twenty minutes – virtually an analogue computer – for which he was awarded 'ten pounds less tax!'; he decided to resign that same day.

Working with IBM, he found the competitive aspects exciting and challenging, though by today's standards, competition was gentlemanly. The common characteristic of people who joined was creativity, and they got carried away, working long hours: 'There used to be a saying, you weren't really in the data processing business unless you'd seen the dawn rise over the equipment.' IBM 'caused things to happen ... it was a mighty team. We got hands on, we learnt to master the things, they weren't frightening any more.'

The inaugural chairman of the Auckland Branch of the Computer Society, he believes the role of the Society now is as important as it ever was, especially as 'a forum of people who ought to know, get their views across, and pick up things they really don't know ... technology and its effect, in general, is rather poorly understood at a political level.'

Today, he says, he looks with real regret at some of the purposeless or trivial uses to which the power of the computer is being put, such as games which become an obsession. 'The intelligence that's been programmed into that little chip is attracting the attention of a human mind to the exclusion of all other humans ... the damage can be real.'

BERNARD BATTERSBY

Bernard Battersby has spent most of his life in Christchurch, where he was born in 1925. His father was an electrical engineer who returned to New Zealand in 1921 following service in the armed forces in World War I. His mother was a war bride. The family lived in Fendalton in a rural environment.

His first school was the Fendalton Open Air School, 'an innovation at that time: which emphasised fresh air and physical health and fitness'. He had a 'highly scholastic' childhood, taking after his father, but his parents did not pressure him to go in any particular direction; he had an interest in finance and commerce so decided to go into accountancy. Because of the war, he had to get as much training as possible before being called up, so he left school at sixteen,in 1941, to earn his own living.

His first job was as office boy with a public accountant, and he attended university part time, completing the New Zealand Society of Accountants qualification and Bachelor of Commerce degree shortly after turning nineteen in 1944 followed in 1946 with a M.Com. with first class honours in Economics. This resulted in the award of a University of New Zealand travelling scholarship in commerce which he took up in 1948 at the London School of Economics after working his passage to England as a deck hand. The trip took three months, and it was an abrupt change in lifestyle for a young man 'still very much attached to mother's apron strings'.

Post-war conditions in Britain were 'fairly miserable', but at the LSE he was involved with brilliant academics: 'One became very modest about one's accomplishments.' In 1951 he returned home after completing a doctorate in philosophy in business finance and soon rejoined his old firm as a partner, but also lectured at the university, so that his working day lasted till nine p.m.

In 1957 he became Dean of the Faculty of Commerce at the University of Canterbury, and in 1961 was appointed to the Monetary and Economic Council advising the government on economic policy – which he later chaired. He recalls Robert Muldoon as 'always very well informed on the economy, and loath to admit that the Council could add to his knowledge'. It was while Bernard was in the United States on a Carnegie Corporation travel grant studying business schools, that he came into contact with computers for the first time. His time at the Carnegie Institute of Technology where the computer business game was 'invented', was the turning point which determined his move into computing; he recognised it as 'something new and exciting that was going to have a tremendous impact on the future'.

The idea of setting up Computer Bureau Limited (now Datacom) in association with Mr P.M. Hargreaves was ahead of its time – many businessmen were cynical, and the company had its teething troubles: begun in 1965, it did not make its first profit till 1969. The enthusiastic staff of seven often worked round the clock; nobody got rich out of it, but 'at least they enjoyed it . . . they found it an intellectual challenge'. Today over 300 people are employed throughout New Zealand

In 1970, Bernard Battersby was elected one of the three Founding Fellows of the Computer Society. He considers the successful establishment of Datacom as a major operator in the computer industry in New Zealand as his major achievement. Datacom has been responsible for a number of 'firsts' for the computer industry in New Zealand companies. Many successful members of the computer industry have received their initial training and introduction to computers at Dr Battersby's hands and he sees the encouragement and support he has given many young people in their computer careers as one of the most satisfying contributions he has made to the industry.

PERCE HARPHAM

Unable to make ends meet in the Depression, Perce Harpham's parents walked off their Poverty Bay farm before he was born in 1932. Building a road on contract, with a pick-and-shovel gang, his father made enough money for a fresh start as a builder.

'Both my parents were, I think, quite exceptional people ... they gave us the great gift of believing that the Harphams were at the top of the pyramid and everyone else was unfortunate. It was a really wonderful piece of confidence to give all their children.'

The youngest of five, he 'played on childhood illnesses' to stay home from school frequently, but still did well, and 'actually used to enjoy doing extra arithmetic at home, working through the examples'.

At secondary school, his health improved; however, he was unhappy because his mother, concerned about injuries, didn't allow him to play football. ('I can sympathise a great deal more with her now.') In the fifth form he started playing rugby surreptitiously, and ended up as captain of the second fifteen.

He had chosen to do the new apprenticeship course; 'There was no tradition or thought of going to university in the family, the horizon was to get University Entrance.' In the sixth form, helped by his technical teacher, he caught up on mathematics and science and got a special bursary. He decided to do chemical engineering, and in 1955 became the first graduate engineer employed by New Zealand Breweries.

'The job should have been a young chemical engineer's dream, but they believed that if you hadn't spent fifteen years shovelling grain out of the mash tub, you couldn't possibly know anything about brewing.' He lasted only six months; job-hunting round every factory in town, he became works study officer with Dulux Ltd, where he stayed for fourteen years.

He first came across computers on an ICI study trip to England. 'I was excited by them – and appalled at the amount of work required to get them to do anything. It was the first time most of us had come up against the implacable logic of the machine . . . that it was always us who were wrong.'

How did others in the company react? 'Really with a great deal of cynicism. There was a mixture of fear and disbelief, and to some extent hoping that it wouldn't work.' He still comes across people who hope computers will go away, 'or at least won't impinge on them before they retire'.

In 1968 he established SPL, Systems and Programs Ltd (now Progeni and one of New Zealand's longest established and most successful software companies). 'We were often 'missionaries' in the software field, but we've found it much easier to sell outside New Zealand. In New Zealand's colonial past, all manufacturing goods had to come on a ship from overseas, and we seem to have been left with the belief that all good things of any complexity come from overseas.' Perce Harpham, on the other hand, has an unbounded faith in New Zealanders and what they can achieve. His only fear is that by failing to encourage our indigenous computer industry 'we won't get the new jobs' which will be created overseas. He, and his company, are playing a significant role in endeavouring to see that this does not happen.

GORDON HOGG

Gordon Hogg is General Manager of Databank, the internationally unique central clearing system for New Zealand banks, which he was mainly responsible for setting up.

Born in Nelson in 1930, he comes of Scottish stock on both sides; his paternal forebears came to New Zealand in 1862,in one of the early ships bringing settlers to Otago. His grandfather bred Clydesdale horses, and Gordon learnt to shoe them when he was barely large enough to lift a horse's foot.

His father was a policeman, very active in community sports groups. 'His attitude was that he could give children other things to do, and he made sure they did them – so he'd start a gym, to keep them off the street. If you had a healthy body, you'd end up with a healthy mind.' Gordon remembers, too, the darker side of life as a policeman's son: the 'wave of fear' through the family when a gunman was on the loose. His father was firm rather than strict; his mother was a shy person who 'gained more and more confidence over the years'.

Gordon was an avid reader who enjoyed learning, but he hated being forced to do compulsory sports – 'though the first thing I did when I left school was to join a rugby team'. He was unable to study civil engineering because returned soldiers filled the course, so his aunt offered to put him through medical school; but 'I had to explain to her, with all her generosity, that I couldn't stand the sight of blood'. Though he had 'never given banking a thought', he joined the Bank of New Zealand, and found he'd made the right move. 'There was always a challenge there that suited my attitude to life.' In the early 1950s, 'things were all going uphill', and at twenty-two he was the youngest securities clerk in the bank. By 1962 he was working in London, a year later he was put in charge of computerisation ('I didn't know a goddam thing about it'). When Databank was set up in 1967, he became its general manager. Today, he believes, 'we are only just seeing the thin edge of the wedge' in computing, which he sees as having a major impact on the whole of society.

Outside his work, one of his main interests is history: 'You understand a lot about what goes on in the world, and why you yourself do things; in fact it motivates you sometimes to do things differently.'

However, he has never regretted going into banking. 'It was an excellent training ground, because it taught you disciplines; everything had to balance, everything was geared to perfection. The whole function of banking is one of the utmost integrity, and certainly as far as Databank is concerned, those early attitudes I developed have carried on. If it's not right, it's not right. The whole time we've been running, we've never had any of our output questioned, and that's a hell of a record.'

NORMA MOFFETT (née Laffey)

Norma Moffett works as Senior Programmer with the Department of Statistics in Christchurch. She was born in Ashburton in 1928, second child in a large family of ten children.

Her mother, born Eva Simpson, was 'an extremely shy person', but a very hard-working, capable manager, and the family lived quite comfortably through the Depression. However, with such a large family, 'food, shelter and warmth were the really important things you worked towards, and I think a little of that feeling of sheer survival is still with us all'.

Her parents had no plans for their children's careers. 'Their aim was to try to keep you at school for as long as possible, and after that it was entirely up to you what direction you took. We were very fortunate in that most of us had three or four years of high school, which was quite an extensive education in those days. There was no distinction between boys and girls, it was expected that we would all get jobs.'

Norma did very well at school, especially in science and mathematics, but had no idea what work she might do. Her first job, 'picked out of the paper by my father', was technician at Wallaceville; but the work was 'bottom of the barrel –

washing test tubes and so on'. Inspired by the graduate researchers who were doing the interesting work, and who included some women, she decided to go to university, and did University Entrance by correspondence in six months. 'There was no pattern or advice, no one to guide me – no one in our family had been to university before. I didn't want to go nursing or teaching, the major occupations open to women in those days. I think a tremendous number of women must have been like me, with no idea of what else was available.'

She worked as a waitress to support herself, and graduated in 1954 with a B.Sc. in zoology, then moved to Lincoln to work in animal research. After marrying, she settled in Wellington and took a part-time job; then, in 1960 her boss suggested that she join the Applied Mathematics Laboratory, which was just beginning to get into computers. Here she was part of the team working on the first computer to come into the country, the IBM 650.

She found the work enormously exciting. 'I used to think, Fancy paying me to have all this fun!' They worked 'impossible' hours, often round the clock. 'I put on a lot of weight – at two a.m. we'd eat great slabs of chocolate, to give us the boost to go on. It was a matter of pride to get the work done.' She thinks that it was easier to learn how computers worked then: 'You were working at such a primitive level, just above machine language, and everything was tangible.'

She missed the job and the people after leaving to have her son in 1965, and looked forward to going back. In 1970 she joined Lane Walker Rudkin, and found that despite the enormous technological progress, her background enabled her to catch up quickly. She stayed until 1980, when she moved to her present position.

She enjoys her work, especially the research aspects; 'Most of those who started off with me are now working at much more senior levels, and have moved out of programming. I have had opportunities to move but I feel that I personally work best in a team, and preferably in the second place.'

BRUCE MOON

Bruce Moon describes himself as 'that peculiar brew which is a New Zealander'. His maternal grandfather was a successful goldminer, an 'able, earnest little man' who dominated five generations of his family; Bruce Moon recalls him and Truby King as 'two rather fierce old men, glowering at each other across a small peninsula'.

His mother, a skilled musician and artist, was not allowed to develop her talents. At eighty-four, she still drives a car and plays the piano. His father, who fought at Paschendaele, worked for the Union Steamship Company; he was 'not a happy man, but a man with a sense of his duty . . . the rage he felt at the deprivations of his own childhood broke through at times'.

Bruce was born in 1930. When he was six, a family move from Christchurch to Bluff was 'a bit of a culture shock for a small boy from a middle class background'. However, the local primary school had an extraordinarily good range of teachers, 'perhaps they had to be'. At secondary school, there was wartime drill with obsolete .303 rifles: 'What we would have done for our country had the Japanese got any nearer, I don't know but at least we were trying!'

As an adolescent, Bruce Moon envied those who knew exactly what they wanted to do. 'My interests are diverse; I'm a generalist, not a specialist, though it's hard for the public to accept that about computer men.' He won a scholarship, and took his degree in physics and mathematics, then set off to work as a Scientific Officer in Australia 'ready to dare all'.

Sent to Britain, he found Farnborough 'a great disappointment . . . an intellectual slum', though he developed a great affection for Britain itself and found the work more satisfying after he had wangled a transfer to the Radar Research Establishment, Malvern, where he first became acquainted with a computer. By 1959, he was back in Australia, but he was unable to get his hands on a workable digital computer. Disappointed by the next job he was given ('I've never willingly accepted organisations and arrangements being imposed upon me'), he returned to New Zealand with his wife Margaret and a new baby, and was soon offered a job with IBM ('Big Blue'). 'We certainly didn't live rich – it was hard work.' When the Computer Society was founded, he joined as an IBM representative.

In 1961 he was appointed as a Senior Lecturer in Mathematics and Director of Computing at Canterbury University. 'I was very keen that the students got hands-on experience, even if it was only one afternoon each ... I soon found that some people have an aptitude for computers, and some don't – rather like musical ability.' A sprinkling of people were obsessively involved with computers, 'but I think in all fairness I didn't become one of them. Instead I tried to dispel the 'black art' concept of computing, and convey something of what it was about to lay people. The real solution is to give a computer to every child to play with, which is just what's happening now.'

By 1981, the university had become 'an increasingly circumscribed environment for me', and he resigned to become General Manager of Business Computers Limited. Recently he decided to scale down to a part-time position: 'While my working days are still far from short, I've been for thirty years more or less at the sharp end of computing, and that's a fair stint for any person.'

GORDON OED

A major force behind the formation of the New Zealand Computer Society, and one of its first three Fellows, Gordon Oed has also had considerable influence in the establishment of management systems and information courses in New Zealand universities. He is currently visiting professor at Manchester Business School.

Gordon Oed comes of English, Cornish, German and Northern Irish descent. Both his parents were brought up in Canterbury, and his father was one of the first to take up a holding on the Levels estate, which he farmed for forty-two years. Gordon was born in 1918; his teenage years were dominated by the Great Depression, aggravated by the severe drought of 1932, 'which saw crops ruined and sheep slaughtered to save them from starvation'. Gordon attended the local schools, and loved farm life; his ultimate objective was 'to do something in the way of agricultural research', but the tragic death of his eldest brother changed the course of his life.

When the time came for Gordon to leave school he joined the Post Office and stayed with it for nineteen years, rising from telephonist at Pleasant Point exchange to Head Office auditor and accountant. As such his work covered research, particularly in the systems area within both the Savings Bank and Accounts Branch Head Offices. His early involvement with EDP, goes back to well before the introduction of New Zealand's first computer. It stemmed from being attached to what was, at that time, a highly secret and confidential army unit working on what was later to become known as radar. The training he was given in radio physics, together with his accounting and commerce background, provided the foundation for his future involvement in EDP.

'Towards the end of the war, information started to be released about electronic computers ... the concept fascinated me, and I read as much as I could of the work of the pioneers, and what was being done overseas.'

Working in the systems area of the Post Office, Gordon could see the potential of the computer for large organisations. He recommended a Giro-type postal clearing system, and the Labour Government passed legislation for its introduction. However, this was repealed by the new National Government in 1960, but the concept of the central clearing system was not to be lost to New Zealand. It was later to be developed through the introduction of the Data Banking System.

In 1962, Gordon Oed joined the accountancy department at Victoria University, and has since led a distinguished and varied academic career. Reflecting on the advent of EDP, he says: 'What was really needed in those days was the ability to think conceptually, a willingness to take risks and to have faith; perhaps we should add the other qualities of hope, and charity for those involved – particularly if things did not work out according to plan!'

Computing power then was a scarce commodity restricted to an elite who could afford it and who had the knowledge and skill to use it. Today the microcomputer has not only made data processing available to many more people but also has added an entirely new dimension to information and at the same time has lowered the level of mathematical and technical knowledge required. Professor Oed is concerned that education has followed technology, rather than vice versa. Because of the ever accelerating rate of change in technology he considers that this own greatest failure has been his inability to persuade educational authorities to promote the concepts of information technology rather than, or in addition to, the narrower technical aspects of computers. With the focus on current technology the inevitable result has been the building of obsolescence into our education system. However, he is optimistic that with the more positive moves in education recently, a more enlightened philosophy will emerge.

LORIN PEKO

Lorin Peko is Management Services Officer for the Wellington City Council. He could have retired in 1980, but promised the Town Clerk that he would 'see the new computer in and on the right path'. He has no intention of getting his own computer when he does retire – 'I can employ myself very nicely, thank you, between bowls and golf and maintaining my hobbies' – but first he has to find his own replacement.

Lorin grew up in Dargaville, 'a very, very introverted close country town', where his father, Mate, still lives at ninety-two. Mate Peko emigrated from Komin in Yugoslavia in 1909; he worked on the gumfields until World War I, fought in the cavalry, and in 1921 married Elsie Robinson, of Irish descent.

Lorin saw little of his father, who was up at five a.m. working in his magnificent garden, at his menswear shop all day and working at the billiard saloon till eleven every night. On Sundays he took Lorin down to the Yugoslav boarding house. Many Dalmatians spoke no English, and 'they were inveterate gamblers – they all worked very hard and clung together in that community to survive'. They tended to spoil children, because many had none.

His mother bore seven children in eight years, of whom six died because of the Rh factor. 'That more or less broke her health – it certainly didn't help it.'

Lorin was interested in 'anything that worked' – clocks, watches, radios. There was no electricity or sewerage in Dargaville then, and only mud roads. A battery radio was their one social contact with the outside world.

He was meant to be a doctor – 'The Dalmatians would stand in the slush all day and scoop out mud, as long as their sons were getting up' – but his parents' disappointment when this didn't happen was mollified by his success at getting a job in the civil service, which was considered 'the greatest plum – a job for life'. So in 1940 he went off to the Audit Department in Wellington, and the next year joined the army, where, as a young sergeant 'in with old lags of twenty-four or five', he learned to drink and also to gamble, with such success that he lived off his winnings and kept all his pay.

In 1953 he applied for a job in Treasury's new EDP unit, and 'although I didn't even know what it was, they had to explain', he won it over 1200 applicants. His wife Edvige – for fairly obvious reasons usually known by her second name, Anne, describes the pressure of work setting up the systems: 'I've known him to come home at five a.m., have an hour's sleep, breakfast, then go back to work... his constant promise was, 'next week will be better'.'

Lorin saw it as a challenge; 'The time passed, you weren't aware of the hours ... you always got a tremendous kick out of putting a new machine in ... you had to be egotistical, the machine wasn't going to beat you.' A strong antipathy to computers was widespread then; today they are accepted as 'just another office tool', and New Zealand is one of the most highly computerised countries in the world. However, 'We shouldn't go overboard. Computers are not the be-all and end-all of what we need – they are the tail, not the dog.'

JOHN ROBINSON

John Robinson was the first male on his father's side of the family who did not go farming. His paternal grandfather came to New Zealand from Cumberland in the 1860s, and first freeholded land near Geraldine in 1873. Born in 1926 John rode a pony to the local fourteen-pupil school. His father's education had finished at twelve; his mother was a trained teacher, and though her family came from Northern Ireland, she had the Scots' concern for education. They were a close family unit, partly because of their isolation.

It was assumed that the boys would take up farming. John passed Matriculation in his third year of secondary school, which his father saw as a landmark; so he stayed on, getting a scholarship in 1943, despite being kept home for a few months to help overcome the wartime shortage of manpower.

So John went on to Canterbury University – where he became probably the first person in New Zealand to be on television. 'The first camera was being unpacked and the lecturer setting it up said to me, 'I wonder if this works – stand still, will you?' Of course I was unaware of its significance at the time.'

With the help of a DSIR scholarship, he took New Zealand's first Ph.D. in structural engineering. 'You learn a lot from doing it yourself and not much from watching anybody else . . . given that you survive it, you probably come out with strengths that you would not have had otherwise.'

He then joined the DSIR's Concrete Research Section. It was the era of the big new hydro developments, and John was seconded to Roxburgh to get more practical experience with the Ministry of Works for five years; then he moved to the MOW in Wellington to set up the new experimental arm ('after a lot of arguing and bureacratic messing about!') which was fundamentally engineering, rather than research.

While on a fellowship to the Massachussetts Institute of Technology in 1956, he saw the very early Whirlwind (first generation computer), but he was 'a gawking observer' only. In a few years, MOW were keen to have their own computer. John recalls its impact: it made it possible to come up, faster, with 'much better judgement and a much better solution', at the same time relieving people of 'a tremendous weight of arithmetic which is just a sheer burden'.

'They say there are four stages of computing: there's fear, there's euphoria, there's disenchantment, then there's cold, stark reality!' In the early 1960s, they were in the 'euphoria' stage. But John Robinson also remembers the enormous stress and pressure, working nights and weekends, which took its toll of family life.

He was a founder member of the Computer Society, but he is wary of seeing computing itself as a profession. 'The computer is just another gadget . . . and like all tools, people who are capable of using it will stand to gain a lot, people who aren't will be therefore relatively disadvantaged. I don't know what the hell you do about it.'

TOLMIE SCOULAR

Tolmie Scoular is a senior partner with the same accounting firm which gave him his first job, as an office boy, in 1944. He was born in Dunedin in 1926; his father was a civil engineer with the Dunedin City Council, and his mother had been one of the first women in Otago to train as a kindergarten teacher.

His father was not a strict disciplinarian, but 'he held very firm views – he knew right from wrong, and he did not tolerate any wrongs'. His mother also had her own fixed ideas: 'She is a tremendous woman, still alive, with all the attributes of a Scot – determination and sharpness of mind.' Her son remembers her as being 'always there, very supportive – she would never believe anything ill of her children'.

That support was needed when, at the age of ten, Tolmie Scoular contracted polio. 'From that time onwards, I guess my lifestyle changed a little; but my parents, particularly my father, were determined that I was going to be, and think of myself as, nothing different from an ordinary child. He made sure I participated in everything I could do, and he went to great lengths to ensure that I did.'

After nine months in hospital, Tolmie came out using two walking sticks and with his legs in steel callipers. 'If you had to have something like that, then I reckon it was about the right age to get it. You're old enough to understand a little of what's going on, and young enough not to miss what you've never done. Though I had tramped round the paddocks with a football team, I'd never played sport properly, so I never really missed any of that. The friendships I had stayed with me.'

As a young man, Tolmie managed to discard his sticks and callipers, and even learnt to dance. 'I don't think the doctors ever expected me to do what I've done.' He describes the way he walks as 'a series of tricks', using different muscles and balancing himself. Only in recent years has he needed a stick again.

His school years – first at the local primary, then as a boarder at Waitaki Boys' High – he sees as 'effective, not unhappy at all'. Although he says he was not at all brilliant, simply persistent, he obtained University Entrance in three years instead of the usual four. He did well in book-keeping, science and mathematics, and wanted to be an engineer, but because of his disability, his father advised him to take up accounting instead.

Systems accounting was his lead into computers – 'It's essentially a matter of trying to find the best way of achieving a solution to the problem you have in front of you.' Lately he has acquired his own micro, and is developing business systems for his own use. 'Lynn will go off to bed in disgust at midnight, while I'm still trying to solve some little problem.' He believes that computer technology will improve our quality of life, but at the same time will require a higher level of education, 'and many people don't seem to be equipped to cope'. He is concerned, too, about the problem of access to information, 'that's the most difficult problem of the lot'.

PAUL WALKER

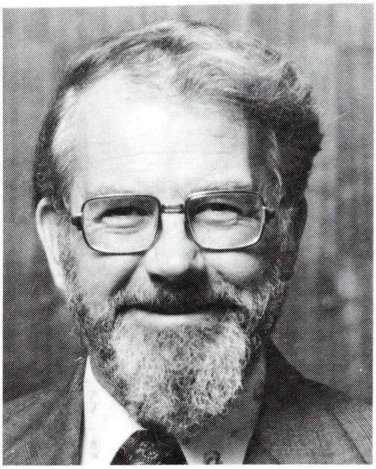
Paul Walker is one of the three Foundation Fellows of the Computer Society. His father, Maxwell, was Professor of Modern Languages at Auckland University. Paul was born in 1914, the youngest of six children.

His mother, Frances, was 'a very pretty, vivacious woman – you couldn't wish for a better mother'. His father was 'a little aloof, a product of the Victorian era – this was the way things were in those days, you looked up to your parents. You weren't allowed to just start chattering at the table, it was speak when you were spoken to.'

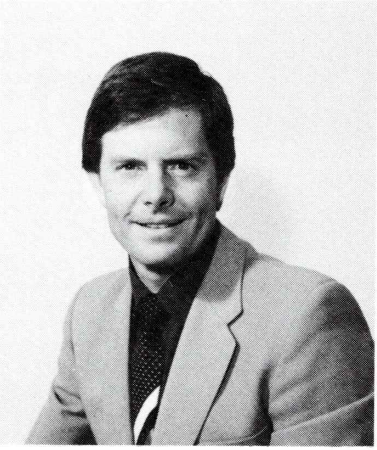
Paul's goal as a child was to earn as much as his father – one thousand pounds a year, a very good salary then. The family lived in a new two-storey house in Herne Bay, (now a motel), with a succession of 'home helps' ('we must have been devils of kids').

Paul was 'always a very logical person', and remembers explaining the solar system when he was seven. At secondary school, teachers encouraged his natural aptitude and interest in mathematics. However, being forced to write right-handed, and go back to using a copybook – 'an utter disgrace' – didn't do him any good: 'My writing now is shocking.' Though always near the top, he was 'never an egghead or a boffin; my reports always said 'could do better''.

At university, he took a B.A. and B.Com. together, and later an M.A. in mathematics, because 'I had only average interest in science, and thought accountancy might be a career qualification'. One year he sat (and passed) eighteen papers, and was told that the whole examination timetable had been arranged around him.

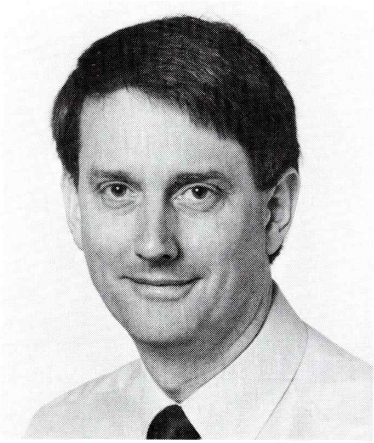


Mr I. W. Lauchland, MNZCS. President of the New Zealand Computer Society 1980-81.



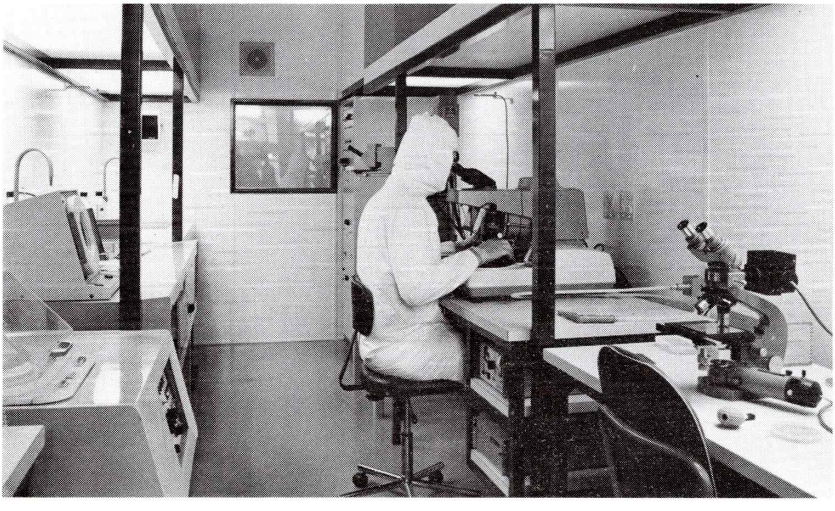
Mr C. J. Potter, MNZCS. President of the New Zealand Computer Society 1981-82.

Mr M. R. Anderson, MNZCS. President of the New Zealand Computer Society 1982-83.



(Above) In May 1983 the New Zealand-owned Paxus Information Services Group acquired the David Hartley Computer organisation of Australia – the biggest computer manufacturer in Australasia. Shortly afterward the Hartley 3923 system won the Australian Design Award for 1984. In the photograph George Wheeler (left), general manager of Paxus Information Group, with David Hartley (right).

(Below) In 1985 the Physics and Engineering Laboratory of the Department of Scientific and Industrial Research opened at Gracefield a silicon wafer fabrication plant. In the photograph: aligning the photomask, a wafer before etching in the lithography room. The production of LSI circuits began in 1985.



When he graduated in 1936, the country was 'just climbing out of the Depression'. After applying for many jobs with no success, he joined the Accounts Division of the State Advances Corporation, beginning a long public service career.

In 1947 he moved to the Public (now State) Services Commission. 'Organisation and methods were the 'in-words' in the 1950s. I've always had a bit of a flair for getting good results by working out the most straightforward, logical way to do things, without wasting any time ... systems designing is only common sense.'

During his next post, with the Air Department (1954-57), publicity started coming in from overseas about the UNIVAC computer system. 'By today's standards, it was absolutely absurd, but logically, it was enthralling.' In 1957 he transferred to Treasury, in time for the first installation of computer equipment. The long hours setting up the early systems affected family life: 'You got pretty tetchy, I'm quite sure, although I wasn't always conscious of doing it.' He learnt to programme the second Treasury computer because he became so frustrated with being 'fobbed off' by the experts the first time.

In 1970 Paul Walker left Treasury to set up Data Enterprises Limited. 'We've seen twenty-five years of computers here now, and the power has increased around 15,000 times. There are still a lot of managers who haven't caught up – they're living in a technology which has gone. To get the full benefit of computers we need a new set of managers who understand the possibilities of this technology, which has simply burst upon us.'

EPILOGUE

There are no prizes for working out the identities of those involved in the following incidents but there is no doubt that they will recognise themselves.

She was Australian and an expert programmer, but this time she was stumped.

She had done all the right things, had carefully debugged the program and established its correctness with a minutely prepared deck of test cards. It had gone into production and then after several production runs the program bombed.

The computer had variable length instructions and each operation code had to be indicated by a bit called a word-mark and now the machine had hung up having branched to an instruction without a word-mark. Something was wrong. After all the program had worked before! The instruction was in the correct place and had performed its function many times. All was well up to the point of bombing. The machine must have dropped a bit and that was the cause of the bug. But the theory did not work out. The error repeated itself exactly. So she followed the standard procedure on that machine. 'Open the control panel, turn the dump knob, press the button' and out would come a memory dump on the printer. Everything was fine in the program except for one thing. All the word-marks up to the faulty instruction had disappeared! She was very quiet for a few days (especially for an Australian), but when she solved it, we certainly heard about it.

The computer had special hardware for editing numeric data for printing commas and periods etc. As part of the edit operation a two-way scan took place with a word-mark being set in the print area, and then cleared at the completion of the second scan. The incorrect use of this instruction, together with certain properties of the edited numeric field, resulted in the second scan extending up memory from the print area to remove a word-mark from an instruction. Gradually as these unusual conditions occurred, the program had its wordmarks eaten away until an instruction in use was reached. The program was gradually destroying itself internally.

After that she invented a group of three self-consistent instructions that could be dropped into anyone's program, with the result that that program would eat itself away to bomb with a completely cleared memory behind it. Fiendish!

* * *

The processing of wool sale accounts in New Zealand, while not the first computer bureau application here, was the first of any size. It revolutionized the industry and resulted in changes to the way the sales were run.

It was my baby and it certainly gave me plenty of problems. I had to find ways of printing totals before the last detail line had been reached and put half the detail lines on the next page if they did not all fit on to the first one. For one report I had to internally sort the wool types for each statement. I thought I had worked out a good technique for speeding up the sorting process only to learn much later at the university that there are significantly better methods. Seeing that the occasional statement took several minutes it would have been nice to know at the time. It was a night and day project. Hands on testing at night and debugging and corrections by day. The strain really came when a colleague bombed out on his program and I had to do that one as well. He just failed to make the transition from punched cards to computer. He went on to sell vacuum cleaners. August 1st 1963 and it was the first wool sale of the season – held in Wanganui. Ready or not, we had to process it. The sale prices were phoned down and punched into cards. At six p.m. we moved into a client's office to buy back the machine time we needed.

At midnight, with part of the job done, we packed up again and moved across town to another client's office to get the use of their extra memory sized machine, all of 12,000 characters! This was needed for the sorts of wool for the growers' accounts. It must have been about three in the morning when we struck problems. My manager had been roped in to write some minor summary report programs but a careful check of his output showed they were faulty. I think that too much RPG had damaged his technique.

Being a manager he was, of course, at home in bed so I had to manage this myself. By persevering I found that I could effectively produce the summary sheets by running in each separate control group by hand.

Back with the customer, the growers' accounts were individually checked line by line before they went out. However it did not take the usual two weeks for the farmers to find out what their proceeds were.

The bugs fortunately did not appear until later. This was the job that made me into a computer professional. After all, I had passed the ultimate qualifying test: I had seen the dawn rise over the computer system while getting the job done.

* * *

For better or for worse she had promised to cherish him – but did this really mean she had to drive from Wellington to Palmerston North in the middle of the night to pick up a programmer, a guest at a wedding there? Paul knew what he had fed into the program. He was the only one who could help to sort out the problem. 'Put an eiderdown and a pillow in the back of the car', her husband said over the telephone at a quarter to one in the morning, 'so that he can sleep on the way – and give him breakfast; then have him here, fresh, at eight o'clock.'

She did it. She still doesn't know why she did it. All those dark miles. She could have said, 'Why don't you go yourself?' but she didn't. Computer wives and computer husbands, like their partners, have to be rather special people.

A SHORT HISTORY OF THE NEW ZEALAND COMPUTER SOCIETY

1960–1985

A survey of the Society's first fifteen years was compiled in 1975 by John Robinson and published in Number II of the BULLETIN in March 1976. It is reproduced here. The story of the remaining ten years has been gathered together by the editor.

'It would be good to have a survey of the Society's first fifteen years for the *Bulletin*,' said the editor. The President looked worried, (probably because it sounded like a proper task for the President himself) but then his seagoing association came to his aid. In the best Press Gang tradition he looked around the Council for the least alert, then replied, 'A very good idea, and I am grateful to John Robinson for volunteering.' The rest of the Council sighed with relief.

1960–1965

The Data Processing and Computer Society was registered by the Registrar of Incorporated Societies on 6 October 1960, with these original Members:- Gordon Oed, W.L. Birnie, E.W. Jones, A.W. Graham, P. Walker, H.F. Foster, J.G. Miller, J.V. Robinson, J.J. Campbell, A.S. Carrington, S.R. Searle, A.D.G. Connor, W.J. Willis and J. Martin. The name was changed to the New Zealand Computer Society on 20 February 1968.

When the inaugural meeting was being set up and the draft constitution was being prepared the main topic of concern and discussion (and a rather surprising one in retrospect) was the seen need to ensure that the machine houses did not take control of this new Society and make it a promotional, rather than a learned one. At least, for those who had been exposed to this view, the way each of the companies formed a phalanx of staff in the Victoria University lecture room at the first meeting seemed to justify this concern. In hindsight this was much more likely to have been due to the fact that they preferred to sit with people that they knew and that company management wanted to help the Society get started by ensuring that it had as many members as possible rather than to any covert intention. However, voting membership was limited to two from each company until the Constitution was changed in 1970.

Wellington Branch was the first, with Canterbury, Otago and Auckland branches following, but there was very little activity on a national basis. The affairs of the Society at that level were in the hands of an Executive Committee which met very infrequently. A Wellington based Standing Committee dealt with the detailed organisational matters for the Executive. By 1965 there was a total of over 200 members in the established branches, Wellington and Canterbury, and Otago and Auckland branches were forming up. This growth made it clear that there needed to be a re-assessment of the Society and its role.

This was discussed at the Executive meeting in October 1965. It was agreed that the Constitution needed review, that the possibility of holding national conferences and of publishing a journal should be assessed, and that nationally organised lecture tours by overseas specialists was still not practical.

1966–1970

During these five years the Society underwent a major rearrangement and national affairs began to increase in importance. A postal ballot was held in 1967 to get the view of the membership on a change of name and on the membership restrictions on machine company staff. There was also a growing concern about the lack of formal education in computing in New Zealand.

Auckland undertook to run the first national conference in 1968. Its success and the opportunity which it gave for a wide section of the membership to discuss the Society, its future direction and some of the issues facing the computer industry such as education, gave a great impetus to both the national activity and overall coherence in the Society.

The Executive and the Standing Committee amalgamated in order to cope with the work necessary for the tasks with which society management had been charged. A report was prepared on the role of the universities in education and research in computing. The Technicians Certification Authority was approached to see whether they would consider extending their certificate to include computing. The Constitution was completely rewritten. The grade of Member was established to identify the 'competent computer professional'. Organisationally the Society was changed from a reasonably loose alliance of individual branches to a national organisation. The implementation of this change was a good deal more gradual than the constitutional change that gave it form.

By the time the second National Conference was held in 1970, however, the stage was set for an effective national organisation.

1970–1975

While the total membership numbers stayed static over this period there was a shift from Associate Member to Member that resulted in a doubling of the number of Members. This typified the changes in this period – a shifting emphasis creating a professional Society. Associated with this, there was acceptance by both the government and the public generally, that the Society was representative of the computer practitioners of this country. The Society responded to this acceptance with an examination of some of the social issues related to the use of computers. This was undertaken not only from a sense of social obligation but also because it was felt that some self regulation by the industry over issues such as privacy could prevent crippling legislative constraint on computing.

It was during this period also that the Society adopted its first logo in the form of four squares, suggesting four punchcards, each showing one of the letters NZCS. The logo was selected from forty-one entries in a competition held in 1971, the winning entry being submitted by Paul Compton of Wellington. The first edition of the Society's quarterley *BULLETIN* made its appearance in October 1973. It was much enlivened by the occasional cartoon from its editor 'Slim' Burns, one of which appears at the foot of this chapter.

In the field of formal education the efforts of the Society were instrumental in getting the Technicians Certification Authority to institute the N.Z. Certificate in Data Processing in 1972. Support of this part-time course has been good and justifies the effort that it took to get it started. While not so direct in effect the report produced by the Society on university education and research helped create a political climate which fostered the growth of computing education in the universities.

Conferences continued to be outstandingly successful and became a well established and valuable part of the Society's activities.

The minimum necessary standard of experience set for transfer to the grade of Member continued to improve. Union membership also became an issue as the growing size of the industry and the differences between computer and clerical work become less marked.

A major activity in the early part of this period was that arising from a motion proposed at the Dunedin conference that the Society investigate a unique identification system to facilitate communication. The original suggestion had been that the study be restricted to commercial communications but members opted for the wider study. After very full discussion and debate in the Society the committee tabled its report which found, inter alia, that it saw no grounds for establishing unique identifiers for use on a nationwide basis. The report was eventually endorsed at a special general meeting in 1972.

1976–1980

The opening years of this period saw three important projects brought to a conclusion. The Code of Ethics, which had been debated for over three years was agreed following consideration at two special general meetings, one in 1976 and the other in 1978. By general consensus the code was to apply to all three main grades; Fellows, Full Members and Associates. The other two projects were related, being the question of registration of computer practitioners and the requirement to join unions. The Society's view on registration was that the time was not opportune for such a move but if it were to be contemplated the Society would wish to be involved in the formulation of the rules and possibly the administration. In the event the government did not follow up the original suggestions. The debate on joining unions centred around programmers who, the union claimed, were carrying out clerical functions. A special committee, set up by the Society to handle the matter, established a good relationship with leading union officials and especially with the Clerical Workers' Union. In the end the status quo was preserved.

The previous period had also witnessed much public and professional concern over proposals for the Health Department computer system. Society members expressed disquiet on two counts; that the prime contractor had been appointed without public tender, that the system they proposed was unworkable. As a result formal representations were made to the Minister of Health, and the President later reported that 'While the Health Department officers were able to quite adequately assure me on the Society's concern relating to the appointment of the consultants, I cannot report that I was equally well satisfied on the degree of technical assurance applied to the acquisition of this major system.' Subsequent events were to prove the Society's reservations were well-founded.

Several procedural changes were made during this period to improve efficiency and lighten the burden of administration. Firstly, the central membership system now in use was introduced; secondly, changes were made to the Constitution which brought more into line with modern practice; and thirdly, the quarterly *Bulletin* was replaced by a monthly news letter published in every issue of the journal *Data Processing in New Zealand*.

Two important reviews were carried out. The first, in conjunction with Victoria and Massey Universities surveyed data processing staff in New Zealand and the second looked at the profile of Society membership. The latter pointed out that while Society membership appeared to cover a satisfactorily wide range of occupations there was low representation from government departments, computer engineers, operators, young people and 'interested amateurs'. It was therefore suggested that recruitment of members should be especially concentrated in these areas.

The subject of privacy raised its head many times during the period. The Society played an active role in the shaping of the Wanganui Computer Centre Act and its subsequent revisions. It was invited to make nominations for the committees to be established under the Act and one of its nominees was eventually accepted. Nationwide publicity was given to the Society's stand on the question of the proposed sale of computer records by a City Council. The Society established its general guideline, later to be expanded into a full position paper, that 'personal information should be used only for the purposes for which it was given'.

Much effort continued to be put into the fields of education and consideration of the impact of computers on society. Typical examples were a most successful series of continuing education seminars and further useful dialogue with the unions on the introduction of computers in the work place, culminating in the sponsorship by the Society of a visit to this country of Kristen and Johanna Nygaard.

1981–1985

The 1980s found the Society becoming involved, to an ever increasing extent, in a wide range of activities. Particularly pleasing was the fact that more and more the Society was being consulted on matters relating to computing, visible proof of the success of early efforts to raise the Society's profile. The extent of this involvement can be gauged from a list of activities taken over a three month period. They included submissions to or work for:

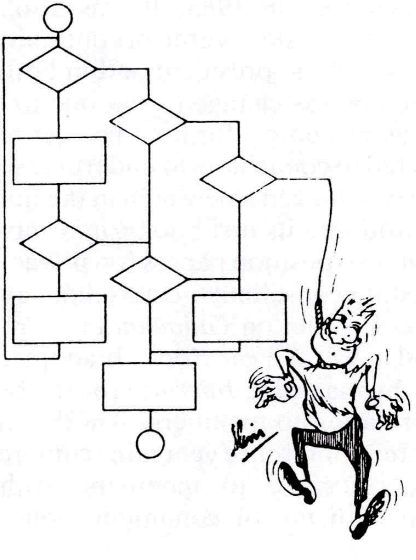
The Auditor General in his review of computing in the public sector.
The Planning Council in response to their position paper 'An Employment Strategy for the 1980s'.
The Communication Advisory Council on the Impact of Viewdata type systems.
State Services Commission on Amendments to the Wanganui Computer Centre Act.
NZ Product Numbering Council – Adoption of Product Numbering Standards for New Zealand.
The Committee on Official Information.
Revision of the Electoral Roll.

It was apparent that all this was placing too great a workload on volunteers from the membership and that more support for committees and project teams was imperative. It was for this reason that, when the then secretary retired at the end of 1980, he was replaced by a part-time executive secretary. The move was seen as the first step towards the Society having available the services of a full-time national staff and office, eventually achieved in 1983. It was also agreed that the opportunity for a greater degree of continuity should be given to councillors and the president and in both cases the initial term on election was changed from one to two years. More emphasis was placed on forming project teams, not necessarily restricted to councillors to undertake specific activities.

The Society achieved a new high in the number of its publications. It produced its first book *Choosing Your First Computer System*, two position papers (on privacy and education), a booklet listing consultants, counsellors and expert witnesses, a further booklet on *Guidelines on Privacy – Security – Integrity* and a *NZCS Year Book*. It adopted a new logo and changed to the magazine *Interface* for the regular dissemination of information to members. Another first was the concept of an inter-conference year mini-conference. RUTHERFORD 84, restricted to members, with New Zealand speakers on a theme of communications, presented in a lighter vein, was voted a great success by those who attended.

However if one activity were to be highlighted it would be that of education. The Society's Continuing Education Programme was strengthened and put on a professional footing by the appointment of a Director of Continuing Education which enabled an ambitious and successful programme of seminars to be launched. The Society assisted in the formation of the Computer Education Society both at regional and national levels, played an active role in the deliberations of the Consultative Committee on Computers in Schools and with the Vocational Training Council. The Society also took active steps to improve the professional standing of its members by setting new requirements for advancement to the professional grade of Full Member. Greater emphasis was given to the acquisition of formal academic qualifications. For this purpose an Accrediting Committee was set up to evaluate the courses available in New Zealand.

And finally, the Society, with its 2,500 members, moves into its Silver Jubilee Year. But that must be another story.



PRESIDENTS OF THE NEW ZEALAND COMPUTER SOCIETY

Professor G.V. Oed, FNZCS	1961-1967
Dr G.B. Battersby, FNZCS	1967-1969
Professor T.K. Cowan, MNZCS	1969-1971
Mr A.J. Henley, MNZCS	1971-1972
Mr P.W. Harpham, FNZCS	1972-1973
Dr B.G. Cox, FNZCS	1973-1974
Dr J.V. Robinson, FNZCS	1974-1975
Mr G.J. Barnard, MNZCS	1975-1976
Mr T.A. Scoular, FNZCS	1976-1977
Mr D.I. Brown, MNZCS	1977-1978
Mr B.A.M. Moon, FNZCS	1978-1979
Mr B.A. Wickes	1979-1980
Mr I.W. Lauchland, MNZCS	1980-1981
Mr C.J. Potter, MNZCS	1981-1982
Mr M.R. Anderson, MNZCS	1982-1983
Dr C.R. Boswell, MNZCS	1983-1985

NATIONAL COUNCILLORS NEW ZEALAND COMPUTER SOCIETY

SURNAME	*INITIALS*	*YEARS*
Anderson,	B.T.	1975-1977
Anderson,	M.R.	1978-1982
Barnard,	G.J.	1967-1968; 1971-1977
Barr,	J.G.	1982
Barrett,	G.R.	1976-1977
Battersby,	B.	1967-1971
Bell,	M.L.	1974-1976
Bieleski,	I.P.	1983-1985
Bigby,	A.	1981-1982
Birnie,	W.L.	1961-1962
Blackham,	A.J.	1982
Boswell,	C.R.	1978-1985
Botheway,	D.A.	1978-1981
Boutel,	B.E.	1982-1984
Brandwood,	G.	1965-1977
Brown,	D.I.	1964-1965; 1972-1979
Bulder,	H.	1983-1984
Clarke,	B.J.	1982-1984
Compton,	D.	1968-1970
Cooper,	K.J.	1981
Cowan,	T.	1965; 1968-1972
Cox,	B.	1968-1975
Cribbens,	P.J.	1972-1974
Davies,	B.	1972-1974
Davy,	G.R.	1968-1972
Doherty,	R.H.	1983-1984
Donald,	B.R.	1979-1981
Emerson,	E.	1982
England,	A.J.	1975-1976
England,	Y.A.	1974-1976
Fitzgerald,	E.D.	1977-1980
Foster,	H.F.	1961-1965; 1967
Gifford-Moore,	B.	1964-1965
Goldfinch,	D.E.	1975-1976
Good,	J.	1979-1982
Gough,	R.M.	1975-1977
Graham,	A.W.	1961-1965

Hargreaves,	P.M.	1970-1973		
Harpham,	P.W.	1968-1975		
Henley,	A.J.	1969-1973		
Hicks,	J.	1965-1967		
Higgins,	J.A.	1981-1985		
Hill,	J.	1978-1980		
Hughes,	D.W.	1984-1985		
Jackson,	L.F.	1963-1965		
James,	N.S.	1982-1985		
Jones,	E.	1961-1967		
Lauchland,	I.W.	1973-1975;	1979-1982	
Lightfoot,	K.	1981-1982		
Marett,	W.B.	1984-1985		
Martin,	M.	1972-1974		
Martin,	R.C.L.	1973-1974		
Matthew,	R.H.	1976-1977		
McConnell,	K.J.	1983-1985		
McCormick,	B.	1975-1976		
McNab,	B.J.	1969-1973		
Middleton,	R.	1970-1972		
Mitchell,	K.I.	1979-1985		
Mole,	P.W.	1978-1981		
Moon,	B.A.M.	1965;	1971-1972;	1977-1980
Moore	K.	1976		
Morgan,	J.D.	1963-1965;	1968-1973	
Neilson,	N.	1971-1972;	1975-1978	
Nutsford,	J.E.	1974-1975		
Oed,	G.	1961-1967		
Page,	G.E.	1974-1976		
Payne,	R.B.	1965-1969		
Persson,	O.G.	1973-1976		
Petraska,	S.	1975		
Potter,	C.J.	1974-1982		
Roberts,	J.R.	1968		
Robinson,	J.V.	1962;	1965-1976	
Rodger,	W.G.	1961-1963		
Rosling,	A.F.	1974-1975		
Rudman,	T.	1976-1978		
Rudolph,	E.E.	1983		
Samson,	P.A.	1973-1974		
Sargison,	P.G.	1980-1981		

Scoular,	T.A.	1967; 1969-1978
Sellwood,	Q.B.	1977-1978
Shaw,	F.G.	1969-1971
Smith,	G.	1980-1982
Snell,	B.G.	1976-1978
Stewart,	A.R.	1979-1982
Tate,	G.	1977-1981
Thomas,	L.J.	1984-1985
Thomas,	N.J.	1968; 1970-1972
Thomson,	T.N.	1972-1974
Trent,	M.J.W.	1983-1985
Turland,	C.E.	1975-1977
Turner,	J.C.	1972-1974
Vignaux,	G.A.	1980
Walker,	P.N.	1961-1965
Ward,	M.C.	1981-1982
Weston,	J.	1977-1979
Wickes,	B.	1977-1981
Wilkinson,	A.L.	1977-1979
Williams,	T.J.	1973-1974
Williams,	W.R.	1975-1979
Wilson,	D.A.	1984-1985
Windsor,	C.P.	1980-1982
Wylde,	E.	1973-1974; 1976

GLOSSARY

The basis of this glossary first appeared in the N.Z. Computer Society book *Choosing your first Computer System* and is re-published with some additional material by the consent of the authors, K.I. Mitchell and B.J. Clarke.

The data processing profession coins new words even faster than it invents new equipment. Many glossaries have been published. The following glossary does not pretend to include every term in use – it would need to be many times larger. It includes only those terms which

- * are not explained in the text.
- * are likely to be met in general reading.
- * are strange or confusing.

A/D: [See *analog*]. An Analog/Digital converter receives continuously variable measurements (such as voltage or pressures) and converts them to numerical readings.

Access: The ability to get at stored data. For *efficiency* one may be concerned with 'direct access', whereby any item of data can be reached as quickly as any other, or 'sequential access', whereby to reach a given item of data one must read through all preceding items; in consideration of *privacy and security* of data one may be concerned with 'freedom of access' and granting 'rights of access' to individual password holders.

ALGOL: The algorithmic (q.v.) language. ALGOL is an elegant, block structured language. It is uncommon in commercial work.

Algorithm: A precise statement of the steps necessary to perform a computational process.

Alpha-Numeric: Any coding system or sample of text which includes the alphabetic characters and the numeric digits.

Analog: Continuously variable [Contrasted *digital*].

Artificial intelligence: [See *intelligence*].

Assembler:
a) a program which assembles machine language instruction when given as input a program written in mnenomic codes.
b) a particular language, using such mnemonic codes.

Back-Up: As a noun, the reserve copy of data which has been made for safety's sake in case the working copy should get destroyed. As a verb, to make such a reserve copy.

Background colour: In computer graphics, the colour of the screen (as a whole, or in a region) against which the characters or lines are contrasted.

Background: [Contrast 'foreground']. The background is a load of low priority batch-processing work to which a multi-programming computer may turn its attention when nothing more urgent is required.

Bank switching: A process whereby more memory can be made available to a computer than the micro-processor chip is capable of addressing at any one time.

BASIC: A programming language used mainly on small computers or as an introduction to programming.

Batch: [Contrast *real-time*]. Retaining the input documents until a sufficient quantity has been received and then processing in bulk. Although economical it necessarily imposes delays.

Benchmark: A program or suite of programs used to measure the speed and efficiency of different computing hardware and software. Benchmarks are valuable for comparative purposes but must be used with great caution. Small variations in operating conditions or language design can produce great variation in running times and one must be careful that the benchmark is running under circumstances similar to one's proposed usage.

BIOS: Basic Input/Output System. A sub-system of some CP/M operating system which handles input and output. Only this component needs to be customized to a particular brand of computer.

Bit: The smallest unit of data in a computer; a single off or on mark.

Buffer: An intermediate storage space which permits two processes to proceed at different rates. For example, if a buffer memory is added to a printer then the central processor can blurt out a page of text to that buffer at very high speed and proceed while the printer then slowly draws the material out of the buffer.

Bus: A term borrowed from electrical engineering where it means a major, heavy-duty electrical pathway. In a computer the *data bus* is a common electrical path for data, interconnecting all the computer's components. An *address bus* is another common electrical path on to which is placed a number defining the memory location or the input/output device to be used by the current instruction.

Byte: 8 bits regarded as a unit. In microprocessors it is common for one location, holding 8 bits, to be the minimum addressable quantity of data.

CAD/CAM (CADAM): Computer Aided Design/Computer Aided

Manufacturing; uses high resolution graphics to permit an industrial designer to develop sketches and blueprints directly on the screen. This drafting system may also be coupled (through the database) to knowledge of strengths, sizes and availabilities of materials and of the production schedule. Production capacity.

Card, circuit card: A printed circuit of computer electronics, plugged as a unit into the machine.

COBOL: The major business oriented data processing language.

Compiler: A program which takes a source program written in a high level language and generates, as output, instructions in machine code.

Controller: A circuit card which contains the electronics necessary to direct an input/output device such as a floppy disk drive.

CP/M: A popular operating system on micro-computers.

CPU: Central processing unit:
– in a mainframe computer the central cabinet which obeys the instructions of the program:
– in a micro-computer, the single chip which obeys those instructions.

CTL (CTRL): 'Control' – a label for the extra shift key on a computer keyboard. One key, e.g. 'c', can produce 'c', 'C' with 'shift' down, and 'CTL-C' with 'CTL' down – three quite different symbols.

D/A: [See *analog*]. Digital to analog conversion, the inverse of analog to digital, is the process of taking a numerical value and generating as output a voltage, pressure, sound, angle, etc, which may vary over a continuous range.

Data base administrator: A person who within a firm is given responsibility for the control of the data base. Such a person may have privileged passwords.

Data base manager: A program which stores, fetches and preserves the security of the data in the data base.

Data base: The total collection of data relevant to one organisation. High volume direct access storage technology allows all the data to be collected and made accessible to any program.

Data dictionary: Within a database management system an index on disc storage which permits the system to find the storage location of a data item given only its name.

Debugging: The process of finding the bugs – the errors – in a computer program.

Dedicated: Set aside for one purpose. For example, one terminal may be dedicated as an operator's console, an entire computer may be dedicated to (say) directing a numerically controlled lathe.

Density: The degree to which data is packed on to a recording surface. The usual designations are single, double and quad densities. Density alone is not the only characteristic of the way data is organised on a floppy disk. Disks of the same density written under different operating systems may be incompatible.

Diagnostics: Programming procedures by which the computer may check itself systematically for errors. Diagnostics may be automatically invoked when power is turned on and/or they may be in a separate program, run by the operator.

Digital: Recorded in discrete digits [Contrast *analog*].

Digitizer: A device which can take a continuously varying signal (such as a pressure, a sound volume or the intensity of grey in a pixel(q.v.)) and convert it to a digital number for entry into the computer.

Digitizer pad: A flat tablet on which can be traced drawings or maps. The locations of the moving stylus can be sensed by the computer and converted into pairs of numerical co-ordinates in the memory.

Direct access: [See *access*].

Disassembler: A program (for the use of experts only) which can take a program in machine language and reconstruct a corresponding source program in Assembly language in order that the program may be understood and altered.

Diskette: [See *floppy disk*].

DMA: Direct Memory Access. A facility within a computer which enables input/output or storage devices to transmit data at very high speed in or out of primary memory by by-passing the central processor unit.

Dumb: A dumb device is a relatively simple machine. For example, a 'dumb terminal' is incapable of editing any data typed into it, or storing the conversational history in a local memory. Any clever performances it may seem to achieve are, in fact, all performed by the computer to which it is attached. [See *intelligent*].

Dump: Short for 'core' or 'memory' dump. A listing of all values held in the computer at a particular time. Used for diagnostic purposes.

Expert System: A computer application which uses previously stored knowledge to solve problems.

Fifth Generation Computer: The next (post 1980s) range of computers.

They will use new hardware and software techniques to handle applications such as artificial intelligence and advanced man/machine interfaces not previously possible.

Flippy disk: An old fashioned one-sided floppy disc, modified so that the second side can be used.

Floppy disk: A magnetic recording surface on flexible mylar enclosed permanently in a stout envelope with an access slot for the reading device. Available in 8″, 5.25″ and recently 3″ diameters. A cheap, removeable recording medium. Depending on the fineness of the magnetic writing one disk can hold from 100Kb of data to 2.4Mb. Unfortunately, only one format (the 8″ single-sided, single density format) even approaches an industry standard, interchangeable *between* different makes of computer.

Foreground: [Contrast 'background']. The foreground is the *urgent* work in a multi-programming computer, particularly the servicing of users at their terminals in real-time.

Format: To erase a floppy disk and write on to it a set of track and sector addresses so that the disk is ready for use with a given operating system.

Function keys: See 'Softkeys'.

Generation: A reference to the relative modernity of the computer: first generation used valves, second generation used transistors, third generation uses integrated circuits....

Generator, program: [See *program generator*].

Graphics: A facility for drawing line and block diagrams and animating them on the computer screen.

Green screen: A VDU or monitor which uses bright and dark green rather than black and white. More restful to the eyes.

Hardware: The physical computer and its associated peripheral equipment.

High level: The higher the level of a language the more is accomplished with each command and the more problem-oriented (less machine-oriented) are the commands.

High resolution graphics: Graphics in which the lines can be drawn with more detail.

Hires: See High Resolution Graphics.

Intelligence, artificial: The fruits of research trying to simulate human-like behaviour and apparent *understanding* in machines. Seen most commonly in game-play machines and in talking devices.

Intelligent terminals, cables, modems: Devices which have enough sophistication in their electronics to be able to perform some processing or decision-making functions themselves, thereby taking a load off the central processor. For example, an intelligent terminal may provide considerable local editing ability, which would otherwise be performed by the remote computer.

Interface: The point where one sub-system meets another. An interface might be defined by mechanical specifications (e.g. the electrical and physical rules governing an RS-232C connector) or by human-oriented procedures (as in an order – entry program).

Interpreter: A program which interprets another program. With the BASIC language the source program sits in its original, readable form in the memory and the interpreter decodes each line as it is to be obeyed. Contrast this with a compiler which converts the source program into machine code. Although an interpreter interprets slowly it is easy for the user to modify the program.

Interval timer: The equivalent of a built-in stop watch, which can be read by programs as it counts up or down and can be made to interrupt a program at the end of an interval. A real-time clock can be simulated.

Jumper: A small plug or wire inside the computer which is inserted or removed to alter a circuit.

Kilobyte (Kb): One thousand bytes (q.v.).

Knowledge Engineering: Where it applies to computers, covers techniques for the automatic manipulation of knowledge, as opposed to data, and problems solving.

LAN: [See *Local Area Network*].

Language card: A circuit board to be plugged into a slot in a computer to provide the additional facilities needed to enable that computer to work with another programming language. The facilities will usually include the compiler or interpreter (in ROM) and may include additional memory. This approach is more common with computers which have their operating systems in a ROM and is less common with disk-based operating systems.

Letter-Quality: A quality printer capable of producing output as clean and crisp as the best typewriters.

Light Pen: A hand held, pencil-like device which can be touched to the VDU screen. A program can detect where upon the screen the pen touches. By this means an operator can select choices from a menu without using the keyboard.

Link: Verb; to join modules of a program together. These modules may have been assembled or compiled at different times and held in a library.

Local Area Network: A regional association of computers and storage devices connected together by communication lines. 'Local' in the sense that this network may in turn be connected as a whole to a distant network.

LOGO: A language used mainly in education (particularly of young pupils via computers and in a mood of discovery and exploration). Often used to direct a moving spot on the screen, called a Turtle, to generate patterns.

Machine language: The fundamental instruction codes to which a given processor actually responds.

Macro: A string of text – usually a small fragment of program – which can be defined at the beginning of a program, given a brief name and automatically inserted into the program wherever that name is used.

Mainframe: Short for 'mainframe computer'. A large computer as opposed to a 'mini' or a 'micro'.

Megabyte (Mb): One million bytes (q.v.).

Memory mapping: Technique whereby input/output devices (in particular each of the character positions on a VDU) are matched with *memory* locations. This makes programming simpler and often increases the speed with which displays may be altered on the screen.

Modem: Modulator – demodulator; a device which converts digital codes into different pitch levels of sound for transmission over telephone lines.

Module: Any unit which is designed to perform one distinct function and/ or to be packaged as one distinct unit.

Monitor: TV screen or VDU with a very high quality image, connected directly to the electronics of the computer. Therefore the image signal is not degraded by being first converted to TV broadcast frequencies and then decoded.

Mother-Board: Master circuit card into which all the other circuit-cards ('daughter boards') are plugged.

MP/M: The multi-processing, multi user version of the CP/M operating system.

MSDOS: An operating system, for the IBM Personal Computer among others.

OASIS: An operating system.

Operating system: The master control program which runs the whole computer and provides services to the application programs.

Parallel: [Contrast with *serial*]. Parallel transmission occurs when each bit of the byte has its own wire to travel along. Parallel transmission is faster than serial but requires a more complex conducting cable.

PASCAL: An elegant, modern, block-structured high-level language.

PCM: [See plug-compatible manufacturer.]

Peripheral devices: Input/output machines, such as VDUs, keyboards, card punches and readers and disk drives.

Personal computer: A micro-computer cheap and small enough to be suited to home use.

Plug-Compatible manufacturer: [*PCM*]. Plug compatible equipment is machinery made by one manufacturer to be identical in its function and interfaces with another manufacturer. Thus when (say) IBM announces a new computer then a host of smaller manufacturers hasten to produce plug compatible units for it.

Pop: [See *stack*]. To obtain off the stack (q.v.) the next item awaiting.

Port: An input/output connection point. A port will have an address number by which programs can refer to it internally and an external socket to which devices may be plugged.

Program generator: A program which writes programs when given some relatively general description of the task to be performed, in a very high level language.

PROLOG: Yet another programming language. The letters stand for 'Program Logic'.

Protocol: A defined set of rules by which one machine talks to another. Usually associated with telecommunications networks.

Push: [See *stack*]. To place an item into the stack (q.v.).

RAM: Random Access Memory; integrated circuit memory in which data can be both written and read, as distinct from ROM which cannot be written to.

Random access: A physical provision for accessing (q.v.) data whereby any part of the data can be reached in the same (short) interval of time as any other.

Real-Time: [Contrast *batch*]. A mode of processing in which every event or transaction arising in the real world is transmitted immediately to the computer. It evokes an appropriate response and any consequential action, such as a message, report or decision is transmitted back to the real world without delay.

Real-Time clock: Circuit card or chip within the computer which can furnish the date and time to any program. It could also be used to initiate programs at predetermined times. With battery back-up it does not fail when the power is turned off.

ROM: Read Only Memory; integrated circuit memory which can be read from but not altered by writing to. Usually pre-programmed at the factory with instructions or data.

S-100 bus: [See *bus*]. A standardized multi-connector slot with 100 contacts each with a precisely defined role. Manufacturers may produce equipment to plug into such a standardized bus with assurance that it will prove compatible.

Scratch: Free or available, as in 'a scratch tape'.

Screen editor: An editor is a program for revising data files by the insertion, deletion, alteration, etc of lines or individual character strings. With a screen editor the VDU appears to be a 'window' into the file. Alterations, taking place visibly on the surface of the screen, are immediately reflected in alterations to that file.

Scrolling: Moving smoothly up the surface of the VDU as new lines appear at the bottom.

Sequential access: A form of access (q.v.) in which items are read in turn. To get to the nth record it is necessary to read through and past all the preceeding n-1 records.

Serial: [contrast *parallel*]. A connection or line in which all the 8 bits of the data are transmitted in turn on one wire instead of simultaneously along 8 wires.

Softkeys: A set of keys on a VDU keyboard which have no pre-defined functions. They may either be used to transmit simple key-identification codes into the computer or they may be set to generate character strings of arbitrary length when pressed. In either case they provide a means by which a program may customize the keyboard to a particular application.

Software: The programs (sets of instructions) that enable the computer to perform its required tasks. Hence:–

Software House: A firm which writes programs and systems.

Spreadsheet: A method of displaying accounting data. In the electronic version the user enters into the rows and columns both initial data values and the relationships between those data values. When any datum or relationship is changed the entire spreadsheet is re-calculated immediately and the impact of a managerial decision or environmental change in a problem can thus be seen immediately.

Stack: An organisation of a queue of items in the machine's memory (or a queue of requests waiting to be serviced by the machine) so that the most recent item placed upon the stack ('pushed on') will be serviced first (when it is 'popped off'). A 'Last-In-First-Out' queue.

Status line, port: A wire or input/output port whose purpose is to advise the computer of the status of a logically adjacent input/output port for data. The value of the status line will declare whether, for example, the input port has data present on it waiting to be read.

Strings: Jargon for 'sequence of characters'.

Synthesizer: A device which generates sound. It does not merely echo pre-recorded sounds but synthesizes any sound desired out of a range of basic sonic elements. Both music synthesizers and voice synthesizers are available.

TPI: Tracks per inch – the number of recording tracks on one radial inch of a floppy disk. The higher this number the greater amount of data stored on the disk. [See *density*].

UNIFLEX: An operating system.

Utility program: A program, often provided by the manufacturer, designed to perform service chores for the user (such as sorting a file into order).

VDU (visual display unit): The television-like part of a terminal on which the computer displays its output. Also used to mean the whole terminal.

Virtual: 'Not real'; used where some hardware feature is being simulated by a program or another hardware feature. For example, 'virtual disk' is apparently a disk drive but is in fact main memory; 'virtual memory' is apparently primary memory but is in fact disk drive; a 'virtual computer' could give the user the sensation of using Machine A while in fact using only a small section of a larger Machine B.

Voice synthesizer: [See *synthesizer*].

REFERENCES

CHAPTER ONE
AOTEAROA BEFORE THE COMPUTER

Elsdon Best, *The Maori School of Learning: Its Objects, Methods and Ceremonial*, Wellington, Government Printer, 1959.

A.T. Ngata and P. Te H. Jones (ed) *Nga Moteatea*, Wellington, The Polynesian Society Inc, Vol. I-III.

D.R. Simmons, *The Great New Zealand Myth,* Wellington, A.H. and A. Reed, 1976.

Pei Te Hurinui, 'Maori Genealogies', *The Journal of the Polynesian Society*, Vol. 67, No. 2 (June 1958).

Raymond Firth, *Economics of the New Zealand Maori,* Wellington, Government Printer, 1959.

Saul H. Riesenberg, 'The Organisation of Navigational Knowledge on Puluwat', *The Journal of the Polynesian Society,* Vol. 81, No 1 (March 1972).

S.M. Mead, 'Imagery, Symbolism and Social Values in Maori Chants', *The Journal of the Polynesian Society*, Vol. 78, No 3 (September 1969).

Donald H. Sanders, *Computers in Society*, Sydney, McGraw-Hill, 1973.

CHAPTER TWO
FROM MONSTERS TO MICROS

This chapter is based on a much more detailed paper prepared by G.J. Tee entitled 'The Early History of Computers' scheduled for publication in the Jubilee edition of the Society's Proceedings.

Anonymous (signed A. A. L; i.e. Augusta Ada Lovelace), 'Sketch of the Analytical Engine invented by Charles Babbage Esq; by L.F. Ménabréa of Turin, Officer of the Military Engineers; from the Bibliothèque Universelle de Genève, October 1842, No. 82. With notes upon the Memoir by the Translator', *Taylor's Scientific Memoirs*, 3 (1843).

Beard, Maston & Pearcey, Trevor, 'The genesis of an early stored-program computer: CSIRAC', *Annals of the History of Computing*, 6 (1984).

Bromley, Allan G., 'Charles Babbage's Analytical Engine', *Annals of the History of Computing*, 4 (1982).

Butler, Samuel, *Erewhon, or, Over the Range,* London, Chapman & Hall, 1872.

Hawkins, William F., 'The first calculating machine (John Napier, 1617)', *The New Zealand Mathematical Society Newsletter*, 16 (1979), Supplement.

Hodges, Andrew, *Alan Turing: the Enigma*, London, Burnett Books, 1983.

Lavington, Simon H., *Early British Computers,* Manchester University Press, 1980.

Mackie, W., *A Noble Breed: The Auckland Racing Club, 1874-1974,* Auckland, Wilson & Horton, 1975.

Merzbach, Uta C., *Georg Scheutz and the First Printing Calculator,* Smithsonian Studies in History and Technology, No. 36, Washington D.C.; 1977.

Metropolis, N. & Worlton, W.J., 'A trilogy of errors in the history of computing', *Proc. First U.S.A.-Japan Computer Conf., 3-5 Oct. 1972, Tokyo.,* AFIPS Inc; Montvale N.J., 1972.

Randell, Brian (editor), *The Origins of Digital Computers: Selected Papers* (third edition), Berlin, Springer-Verlag, 1982.

Rejewski, Marian, 'How Polish mathematicians broke the ENIGMA cipher', *Annals of the History of Computing*, 3 (1981). Translated from the Polish original, published in Annals of the Polish Mathematical Society, Series 2, *Wiadomósci Matematyczne,* 23 (1980).

Stewart, David & Minto, Walter, *An Account of the Life, Writings and Inventions of John Napier of Merchiston,* R. Morrison, Perth, 1787.

Tee, Garry John, 'The pioneering women mathematicians', *Mathematical Chronicle* 10 (1981), Reprinted in *The Mathematical Intelligencer* 5 (4) (1983).

Tee, Garry John, 'Two New Zealand mathematicians' (L.J. Comrie & A.C. Aitken), *First Australian Conference on the History of Mathematics*, Department of Mathematics, Monash University, Clayton, Victoria, 1981.

Tee, Garry John, 'The heritage of Charles Babbage in Australasia', *Annals of the History of Computing*, 5 (1983), Reprinted in *The Word Te Reo* (August 1983).

Tee, Garry John, 'Charles Babbage (1791-1871) and his New Zealand connections', *In Search of New Zealand's Scientific*

Heritage, Bulletin 21, The Royal Society of New Zealand, Wellington 1984.

Wilkes, Maurice V; Wheeler, David J. & Gill, Stanley, *The Preparation of Programs for an Electronic Digital Computer*, Cambridge, Mass, Addison-Wesley Press, 1951. Facsimile edition by Tomash Publishers, Los Angles/San Francisco, 1982.

CHAPTER SIX
EXPERT SYSTEMS AND THEIR IMPACT ON THE PROFESSIONS

Evans, Christopher, *The Mighty Micro,* Victor Gollancz, 1979.

Simons, G.L., *Towards Fifth Generation Computers*, N.C.C. Publications, 1983.

Wrightson, G., 'Knowledge Engineering: State of the Art and Future Prospects', scheduled for publication in the Silver Jubilee edition of the Society's Proceedings.

CHAPTER EIGHT
COMPUTERS IN EDUCATION

Apperley, M.D., Micro Which? (1980), Notes on Universities.

Boswell, C.R. and Melhuish, P.J., 'Computer Education in New Zealand.' (1978).

Jackson, I.F., 'Computers in New Zealand: People, Education and Training' – for Vocational Training Council (METAC EDP Working Party), 1983.

Mitchell, K.I., 'Computers and the Future of Education' – address to the NZ Educational Administration Society, October 1984.

Marshall, Hon. C.R., '1984 Learning in the Computer Age' – address to the NZ Educational Administration Society, October 1984.

Papert, S., *Mindstorms: Children, Computers and Powerful Ideas*, Basic Books Inc., 1980.

Wagner, G.A., 'National EDP Skills and Training Needs Survey' – NZ Council for Educational Research, for Vocational Training Council (METAC EDP Working Party), 1984.

Report of the Consultative Committee on Computers in Schools, Department of Education, February 1982.

Position Paper on Education and Vocational Training in Computer Studies, New Zealand Computer Society, 1981 and 1983.

The DACUM Conference, Vocational Training Council, 1983.

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CHAPTER TEN

A NEW INDUSTRY FOR NEW ZEALAND

Jones, Barry, *Sleepers Wake*, Oxford University Press, 1982.

Stuart, G.F. and McCullock, D.G., *Technology and Innovation in the N.Z. Manufacturing Industry*, DSIR, 1980.

IDC Study of the Electronics Industry.

OECD Committee for Information Computer and Communications Policy (ICCP). Update of Information Sector Statistics, September 1984.

Some Preliminary Figures from the DSIR Survey of the N.Z. Software Industry, August 1984. Full DSIR Discussion Paper due for publication in April 1985.

THE NEW ZEALAND COMPUTER SOCIETY

It is typical of the forward thinking of the New Zealand Computer Society that it was formed before the first electronic computer reached our shores. Motivated by the twin aims of developing a body of professional competence among computer practitioners and ensuring that New Zealand reaps the full benefits to be gained from the 'New Technology', it early established technical and ethical standards and endeavoured to increase public awareness of the computer's potential.

It has also forcefully, and with some success, defended the rights of individuals, condemning those practices which it regards as improper. It has promoted the role of computers in education and their use in helping the disabled. It provided initial funding and assistance for the New Zealand Computer Education Society and the Technical Aids Trust, and continues to support both bodies.

The Society celebrates its Silver Jubilee with a membership of 2,500 of whom some 450 are in the professional grade of Fellow or Member. It does not intend to rest on its laurels. There can be little doubt that the electronic age is here to stay and, properly managed, will benefit us all. For this the managers will need to be both properly qualified and fully aware of their social obligations. It is here that the Society feels it has a major role to play.

NZCS